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SMITHSONIAN INSTITUTION
UNITED STATES NATIONAL MUSEUM
Bulletin 106

# NORTH AMERICAN EARLY TERTIARY BRYOZOA

BY

FERDINAND CANU
*Versailles, France*
AND
RAY S. BASSLER
*Washington, District of Columbia*

## TEXT

WASHINGTON
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# ADVERTISEMENT.

The scientific publications of the United States National Museum consist of two series, the *Proceedings* and the *Bulletins.*

The *Proceedings*, the first volume of which was issued in 1878, are intended primarily as a medium for the publication of original, and usually brief, papers based on the collections of the National Museum, presenting newly acquired facts in zoology, geology, and anthropology, including descriptions of new forms of animals and revisions of limited groups. One or two volumes are issued annually and distributed to libraries and scientific organizations. A limited number of copies of each paper, in pamphlet form, is distributed to specialists and others interested in the different subjects as soon as printed. The date of publication is recorded in the tables of contents of the volumes.

The *Bulletins*, the first of which was issued in 1875, consist of a series of separate publications comprising chiefly monographs of large zoological groups and other general systematic treatises (occasionally in several volumes), faunal works, reports of expeditions, and catalogues of type-specimens, special collections, etc. The majority of the volumes are octavos, but a quarto size has been adopted in a few instances in which large plates were regarded as indispensable.

Since 1902 a series of octavo volumes containing papers relating to the botanical collections of the Museum, and known as the *Contributions from the National Herbarium*, has been published as bulletins.

The present work forms No. 106 of the *Bulletin* series.

William deC. Ravenel,
*Administrative Assistant to the Secretary,*
*In charge of the United States National Museum.*

Washington, D. C., April 20, 1920.

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# NORTH AMERICAN EARLY TERTIARY BRYOZOA.

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## INTRODUCTION.

### PREPARATION AND SCOPE OF THE WORK.

Although the great abundance and splendid preservation of the bryozoa in the Tertiary rocks of the Atlantic Coastal Plain and the Gulf region have been known to students since early in the last century, so little attention was paid to this class of organisms that the publications upon them number scarcely more than a dozen. Moreover these, with a very few exceptions, give so imperfect an idea of the comparatively few species described that the field of American Tertiary bryozoology may be considered as almost a virgin one.

Upon his appointment to the division of paleontology in the United States National Museum in 1901, the junior author of this monograph began to accumulate collections of American Tertiary bryozoa. In a few years sufficient material had been assembled and studied in a preliminary way to prove the great value of these organisms in the most detailed stratigraphic correlation. When it is known that at many localities exposing Tertiary strata the bryozoa are practically the only fossils to be found, the need of this systematic study, if only for correlation purposes, is apparent.

In 1907 when the Coastal Plain Investigations of the United States Geological Survey were reorganized with Dr. T. Wayland Vaughan in charge, the active cooperation of Doctor Vaughan and his assistants was secured in furthering the collecting of bryozoa. By 1912 the collections resulting from these combined efforts had become so large and numerous that the Director of the Geological Survey, upon the recommendation of Doctor Vaughan, proposed that the materials be made the subject of a monograph. The junior author assented to the plan but soon found that one person alone could not hope to complete the necessary work in a reasonable length of time. Besides, the intimate relationship of the Tertiary bryozoa with the living forms required a good knowledge of the taxonomy and anatomy of the recent species on the part of the student who attempted the description of the fossil forms. With the consent of the Geological Survey authorities the junior author thereupon proposed to Ferdinand Canu, of Versailles, France, whose studies had been mainly on the Tertiary and Recent bryozoa of Europe and South America, to join him as senior author in the work. Upon his consent, the study, description, and illustration of the numerous American species were energetically pursued and much progress had been made previous to the outbreak of the great war. This was naturally lessened by the civil mobilization of the senior author, but he was still enabled to spend a portion of his time upon the work. By the end of 1917, in spite of other exigencies arising from the war, the present monograph, comprising over 700 species of lower Tertiary bryozoa, had been completed and the study of the upper Tertiary forms much advanced. In view of the necessarily slow publication of a large paleontological work, the authors early in 1917 issued preliminary descriptions of certain new genera and families, published as Bulletin 96 of the United States National Museum, under the title: A Synopsis of American Early Tertiary Cheilostome Bryozoa.

The Tertiary bryozoa belong almost entirely to the two orders Cyclostomata and Cheilostomata, the number of the latter being almost double that of the former. In North America the Midwayan, Wilcoxian, Claibornian, Jacksonian, and Vicksburgian groups contain by far much larger faunas of this class than the succeeding rocks. For convenience only, the above-named groups have been designated as the Early Tertiary and their bryozoa are described in the present volume. The study of the American Miocene, Pliocene, and Pleistocene species has been completed and it is hoped that their description can be published in the near future.

With a very few exceptions all of the type-specimens described and illustrated in the present volume are contained in the paleontologic collections of the United States National Museum. The Museum catalogue numbers are given in the plate descriptions. The station locality numbers of the United States Geological Survey are cited on pages 15 and 16.

The illustrations were prepared by photography, an ordinary 3-inch objective being used in a camera with a long bellows. The photographic prints were locally strengthened only enough to retain the scientific details when the illustrations are reproduced by half tone. It has been found most satisfactory from an artistic standpoint to blacken the apertures in many cases; indeed, this is often the only retouching that the prints have undergone.

The plates are arranged according to the five large geological divisions here treated—Midwayan, Wilcoxian, Claibornian, Jacksonian, and Vicksburgian. Under each of these divisions the species are arranged as nearly in biologic order as possible. It should be noted, however, that any species which occurs in two or more of these divisions is illustrated only under the oldest one. Thus, for example, the illustrations of a species occurring in both the Claibornian and Jacksonian are to be found only on the Claibornian plates.

## ACKNOWLEDGMENTS.

In the accumulation of data and specimens for the preparation of this monograph the authors are indebted particularly to the various geologists of the

Eastern and Southern States where Tertiary strata outcrop, and to the Federal geologists who have encouraged their studies. To Dr. George Otis Smith, Director of the United States Geological Survey, and to Mr. David White, Chief Geologist, obligations are due for their kind interest in the work and for the help of the Survey in the preparation of the work. Especial recognition is due Dr. T. Wayland Vaughan, Chief of Coastal Plain Investigations of the Federal Survey. It was at his urgest request that the study of the American Tertiary bryozoa was undertaken; he has spared no efforts to help the work along, not only by his own personal exertions in supplying both stratigraphic and paleontologic data, but also in having his assistants collect and prepare many lots of fossils for this special study; and his advice and broad experience in all matters relating to the American Tertiary formations have been of inestimable value.

Dr. C. Wythe Cooke, of the United States Geological Survey, has supplied many splendid faunas resulting from his stratigraphic work in Alabama and Georgia particularly. He is the discoverer of the celebrated Vicksburgian locality near Monroeville, Alabama, and it is due to his intelligence and care in collecting fossils and recording stratigraphic data that it has been possible to work out many of the bryozoan faunal zones of the American early Tertiary. Thanks are due to Mr. Wendell C. Mansfield, of the United States Geological Survey, for collections, and to Mr. I. B. Milner, of the same organization, for his care in the preparation and preservation of these hitherto neglected fossils.

Dr. Charles D. Walcott, Secretary of the Smithsonian Institution, and Dr. Richard Rathbun, late Assistant Secretary in charge of the United States National Museum, extended various courtesies during the course of this work and furnished financial assistance for making special investigations and for the publication of the work. Under these auspices the junior author was enabled to make researches, particularly in North and South Carolina, and to collect the very large middle Jacksonian faunas here described.

Dr. Charles E. Resser and Miss Adelaide C. Quisenberry, of the division of paleontology of the United States National Museum, have been of great aid to the junior author throughout the work. Doctor Resser has assisted materially in the preparation of numerous text figures, and Miss Quisenberry has taken a most active interest in the translation and preparation of the manuscript. The retouching of the photographs and the preparation of the drawings have been done by Miss Francesca Wieser, of the United States Geological Survey, whose skill and faithful work is herein again attested.

Mr. Earle Sloan, of Charleston, South Carolina, was most kind in furnishing numerous specimens and in personally conducting the junior author during a trip through the Southern States to classic localities, which, without his detailed knowledge of the country, could not have been found. The splendid faunas from Baldock, Eutaw Springs, and Lenuds Ferry, South Carolina, are due to Mr. Sloan's generosity and interest in the work. Dr. S. W. McCallie, State geologist of Georgia, has also furnished collections which have been of value in studying the Tertiary stratigraphy of that State. Dr. Eugene A. Smith, the first to decipher the correct sequence of lower Tertiary formations in the Southern States, supplied important collections from Alabama, particularly from the Midwayan group.

Ample collections of washings with bryozoa from the typical Jacksonian of Mississippi were secured by Mr. E. N. Lowe, State geologist, who has been ever ready to obtain material to advance these studies. The lower Jacksonian fauna herein described is largely the result of Mr. Lowe's efforts. Mr. John M. Nickles also has contributed specimens for study, particularly from the Midwayan of Arkansas.

The Ulrich collection, now the property of the United States National Museum, has furnished some excellent materials of great use in the present monograph. The authors have also had the advantage of the advice and experience of Dr. E. O. Ulrich, who made these particular collections in the hope that some day the subject would be monographically treated.

Professor H. Douvillé, member of the Institute of France, has verified our classification, and he has been most generous to the senior author with his advice and encouragement. We are sincerely thankful for his help.

The authors are deeply grateful to the National Academy of Sciences for financial assistance which made it possible for them to prepare and include in this monograph the important portion relating to the Cyclostomata, thereby completing the study of the North American early Tertiary species.

## OBJECTS AND METHODS OF STUDY.

There are many minute openings and almost imperceptible protuberances on a fossil bryozoan. Their enumeration, the description of their form, size, and position would be a work both tedious and perfectly useless, unless, by the aid of zoology, a reason for their presence can be obtained. Here, more than anywhere else, the intimate union of zoology with paleontology is absolutely necessary.

The fossil bryozoa are more than small perforated stones. They are the remains of creatures of a former time, and the object of the paleontologist should be their resurrection. His rôle is to animate them in order to classify them, and to classify them correctly in order to use them.

This fertile method of constant comparison with the living specimens is tending to prevail in Europe, but here in America circumstances, notably the predominance of the Paleozoic faunas, have not permitted its application in bryozoology. The present authors have endeavored to inaugurate this method of research in America by a study of the exuberant faunas of the great American Tertiary Gulf. They have endeavored to describe these faunas so as to be understood by all naturalists and not by the specialist alone.

The lack of large monographs upon bryozoology causes the study of the fossil forms to be exceptionally difficult. The most recent monograph, that of Hincks, dates from 1880, and is concerned only with Great Britain. Since that time, it is true, important researches have been made by many eminent naturalists of all countries and published in a great number of scientific works, in all languages. All these works are assembled only in the libraries of the very few specialists who at present study these interesting animals. The paleontologist who has not followed closely the development of all these researches and who is not himself a trained zoologist is absolutely powerless to prepare a useful work. On the other hand, a large paleontologic work prepared by a competent zoologist would be little comprehended by the readers, since they have not been able to study any comprehensive work embodying the more important progress in bryozoology.

The present writers were therefore in a quandary since by preparing a strictly paleontologic monograph they ran the risk of publishing a work incomprehensible and discouraging to students and collectors alike. In order to avoid such a result they decided to closely associate the paleontology and zoology of the bryozoa by the introduction of numerous text figures, wherein the more recent work concerning each of the families and genera considered is illustrated. Naturally this is not as comprehensive a zoologic work as could be desired, but it is sufficient for the exact interpretation of the structure of the Tertiary bryozoa of American strata. This has been supplemented by lists of recent and fossil species under each genus. No attempt has been made to classify all the known species, but the lists are simply complete enough to remain exact.

The terminology of the bryozoa has become somewhat specialized, although it is still far from being very complicated. The reader will easily become familiar with it by the aid of the special drawings scattered among the text figures.

Although the Tertiary bryozoans often occur literally by the million in a stratum, they are usually so inconspicuous as to be unnoticed by the average collector. When these fossils are present a careful examination of a weathered outcrop will almost invariably reveal a few minute twig-like stems or porous, flattened fragments projecting from the surface. Further search along the outcrop, especially along a seam in the rock. is very liable to result in the discovery of many such fragments.

As most of the American Tertiary bryozoa occur in soft limestone or marls, the collection of the material for study consists simply in scooping up a large amount of the loose rock containing these fragmentary remains. If the specimens are found in a hard, indurated rock, it is usually only a matter of search to find a spot where the matrix has decomposed. leaving the soil filled with free specimens. In any case it is not advisable to pick up the specimens one by one, not only on account of loss of time, but also of breakage. On arriving at the laboratory the clay or other rock holding the bryozoans should be allowed to soak in water for some hours. The material may then be agitated and the muddy water poured away. Continuing this process until the agitated water no longer becomes muddy, the residual mass is set aide to dry. The debris when dry is then ready for assorting, although passing it through several sieves of different mesh greatly facilitates the assorting of the contained fossils.

When bryozoa are quite rare in any exposure it is well to do most of the sieving in the field if possible. For example, the interesting lowest Eocene fauna secured at Upper Marlboro. Maryland. was collected only after several days' active work of sieving the sand, and a small pill box was sufficient to hold the entire results.

In case these fossils can not be found in soft rock, it is often still possible to obtain good specimens for study. A comparatively hard fossiliferous rock when crushed in a sack with a wooden mallet will often afford fairly well-preserved fossils after the débris has been washed and sieved as mentioned above. In such a case the bryozoans, although likely to be broken into smaller fragments than usual, are generally well enough preserved for accurate determination. If the rock is calcareous and too hard to yield to such treatment, thin sections may be employed to determine the bryozoa. If the matrix be siliceous the fossils are almost invariably present as molds, in which case gutta-percha squeezes afford excellent results.

The separation into species of the fragmentary specimens resulting from the washings can be made with an ordinary hand lens magnifying eight or ten diameters. The identification of these species can also be made under such a lens providing the species have already been well described and illustrated. In the identification and discovery of the characters of new species, however, a higher magnification is necessary, and also some special sections must be prepared.

*First*, thin sections of the walls, particularly the frontal, are needed to illustrate the characters of the three layers, olocyst, tremocyst, and pleurocyst. *Second*, the frontal must be abraded away to show the occurrence of such structures as dietellae. This abrasion is effected by mounting the fossil, frontal side up, in Canada balsam on a slide and after heating to harden the balsam, rubbing it gently on a soft hone. *Third*, by the preparation of a similar section the interior of the frontal side can be studied. Calcification on the frontal frequently obscures the true form of the apertura and its accompanying structures. These are all well preserved on the inner side of the frontal, so by mounting the fragment in balsam, outer face down, and rubbing away the opposite side, the structure of the interior is clearly revealed. Throughout the description in the present work this section is spoken of as "in the interior." *Fourth*, a section passing lengthwise through the zooecia or individual cells is necessary to determine the nature of the ovicell as well as the general structure. This section requires much care, as the specimen must be mounted on edge and the abrasion must follow a definite row of cells. By the use of small wire nippers it is easy to trim the specimen to just the right form, then by mounting it in hardened balsam between two small bits of wood (fragments of a match serve excellently) to hold it on edge, the abrasion can be continued until the desired section is obtained. *Fifth*, actual dissection of the fossil specimens with a fine needle under the microscope is often necessary, especially to determine the nature of the ovicell.

It will now be evident that the description of the small openings on a fossil bryozoan is the least part of their study and that as refined methods of research may be employed on these microscopic forms as on any other class of animals.

## CATALOGUE OF PAPERS OF AMERICAN EARLY TERTIARY BRYOZOA.

### 1833

LEA, ISAAC. Contributions to Geology. Philadelphia, 1833. 227 pp., 6 pls.

The bryozoa described are as follows; all are from the Eocene at Claiborne, Alabama:

*Lunulites bouci*, p. 189, pl. 6, 202.
*Lunulites duclosii*, p. 190, pl. 6, 203.
*Orbitolites interstitia*, p. 191, pl. 6, 204.
*Orbitolites discoidea*, p. 192, pl. 6, 205.

### 1845.

LONSDALE, WILLIAM. Account of 26 species of Polyparia obtained from the Eocene Tertiary formations of North America. (Quart. Journ. Geol. Soc. London, vol. 1, pp. 509–533.)

*Tubulipora proboscidea* ? (Milne-Edwards), p. 522. Eocene: Rocks Bridge.
*Idmonea maxillaris*, new species, p. 523. Eocene: Wantoot, South Carolina.
*Idmonea commiscens*, new species, p. 524. Eocene: Rocks Bridge.
*Hippothoa tuberculum*, new species, p. 527. Eocene: Rocks Bridge.
*Eschara tubulata*, new species, p. 528. Eocene: Wilmington, North Carolina.
*Eschara petiolus*, new species, p. 528. Eocene: Eutaw, South Carolina.
*Eschara incumbens*, new species, p. 529. Eocene: Rocks Bridge, South Carolina.
*Eschara linea*, new species, p. 530. Eocene: Eutaw, South Carolina.
*Eschara viminea*, new species, p. 530. Eocene: Eutaw, South Carolina.
*Lunulites sexangula*, new species. p. 531. Eocene: Wilmington, Wantoot (?).
*Lunulites contigua*, new species, p. 533. Eocene: Wilmington.

### 1847.

CONRAD, T. A. Observations on the Eocene formation, and descriptions of 105 new fossils of that period from the vicinity of Vicksburg, Mississippi, with an appendix. (Proc. Acad. Nat. Sci. Philadelphia, vol. 3, 1847, pp. 280–299.)

*Lunulites vicksburgensis*, p. 296.

The same paper occurs also in Journ. Acad. Nat. Sci. Philadelphia. ser. 2, vol. 1, 1848, pp. 111–134, pls. xi–xiv.

*Lunulites vicksburgensis*, p. 127.

### 1858.

EMMONS, EBENEZER. Report of the North Carolina Geological Survey. Raleigh, 1858. Paleontology, pp. 193–314.

The only Eocene bryozoan described is *Lunulites contigua*, p. 311, figs. 250, 251. Eocene: Wilmington, North Carolina.

### 1862.

GABB, WILLIAM M., and HORN, GEORGE H. Monograph of the fossil Polyzoa of the Secondary and Tertiary formations of North America. (Journ. Acad. Nat. Sci. Philadelphia, ser. 2, vol. 5, 1862, pp. 111–178, pls. 19–21.)

*Eschara tubulata* Lonsdale, p. 115. Eocene: Wilmington, North Carolina.
*Eschara petiolus* Lonsdale, p. 116. Eocene: Eutaw, South Carolina.
*Eschara incumbens* Lonsdale, p. 116. Eocene: Rocks Bridge, South Carolina.
*Eschara ? viminea* Lonsdale, p. 116. Eocene: Eutaw, South Carolina.
*Eschara texta*, new species, p. 117, pl. 19, fig. 1. Eocene: Charleston, South Carolina.
*Eschara ovalis*, new species, p. 118, pl. 19, fig. 2. Eocene: Claiborne, Alabama.
*Lunulites sexangula* Lonsdale, p. 119. Eocene: Wilmington, North Carolina.
*Lunulites distans* Lonsdale, p. 119. Locality not given.

Gabb, William M., and Horn, George H.—Continued.

*Lunulites interstitia* (Lea), p. 120. Eocene: Claiborne, Alabama.

*Lunulites contigua* Lonsdale, p. 121. Eocene: Wilmington, North Carolina.

*Semieschara tubulata*, new species, p. 122, pl. 19, fig. 5. Eocene: Claiborne, Alabama.

*Cellepora cycloris*, new species, p. 127, pl. 19, fig. 9. Eocene: Claiborne, Alabama.

*Cellepora inornata*, new species, p. 127, pl. 19, fig. 10. Eocene: (?) Claiborne, Alabama.

*Reptocelleporaria glomerata*, new species. p. 134, pl. 19, fig. 15. Eocene: Vicksburg, Mississippi.

*Escharella micropora*, new species, p. 136, pl. 19, fig. 17. Eocene: ? Alabama.

*Repteschareila carolinensis*, new species, p. 136, pl. 19, fig. 18. Eocene: Charleston, South Carolina.

*Oligotresium vicksburgensis* (Conrad) p. 139, pl 19, fig. 22. Upper Eocene: Vicksburg, Mississippi.

*Escharinella ? linea* (Lonsdale), p. 140. Eocene: Eutaw, South Carolina.

*Discoflustrellaria bouei* (Lea), p. 154. Eocene: Claiborne, Alabama.

*Cupularia discoidea* (Lea), p. 155. Eocene: Claiborne, Alabama.

*Heteractis duclosii* (Lea), p. 156, pl. 20, fig. 39. Eocene: Claiborne, Alabama.

*Idmonea maxillaris* Lonsdale, p. 167. Eocene: Wantoot, South Carolina.

*Idmonea commiscens* Lonsdale, p. 168. Eocene: Rocks Bridge, South Carolina.

*Entalophora proboscideoides* (Lonsdale), p. 170, pl. 21, fig. 60. Eocene: ? Alabama.

1882.

Ulrich, E. O. American Paleozoic Bryozoa. (Journ. Cincinnati Society Natural History, vol. 5. 1882).

*Heteropora attenuata*, new species, p. 144, pl. 6, fig. 12. Midwayan: Pulaski County, Arkansas.

*Heteropora consimilis*, new species, p. 145, pl. 6, fig. 11. Midwayan: Pulaski County, Arkansas.

1890.

Gregorio, Antonio de. Monographie de la Faune Eocenique de l'Alabama et surtout de celle de Claiborne de l'Etage Parisien. (Annales de Géologie et de Paléontologie. Livraisons 7 and 8. Palermo, 1890. 316 pp., 46 pls.) The bryozoa described from the Eocene of Claiborne, Alabama, are:

*Crisia laeta* De Gregorio, p. 239, pl. 39, figs. 10, 11.

*Myriozoum propepunctatum* De Gregorio, p. 239, pl. 39, figs. 12–13.

*Myriozoum fervens* De Gregorio, p. 239, pl. 39, figs. 14–15.

*Idmonea subdisticha* De Gregorio, p. 239, pl. 39, fig. 16–20.

*Entalophora proboscidoides* Gabb and Horn, p. 240, pl. 39, figs. 26–27.

*Entalophora amoena* De Gregorio, p. 240, pl. 39, fig. 21.

*Hornera mirifica* De Gregorio, p. 240, pl. 39, figs. 31–32.

*Hornera multiramosa* De Gregorio, p. 240, pl. 39, figs. 28–30.

*Hornera claibornensis* De Gregorio, p. 241, p. 39, figs. 22–23, 33–34.

*Hornera*, species (?) p. 241, pl. 39, figs. 24–25.

*Eschara (?) spongiopsis* De Gregorio, p. 241, pl. 40, figs. 1–2.

*Eschara ovalis* Gabb and Horn, p. 241, pl. 40, figs. 3–5.

*Escharella sifra* De Gregorio, p. 242, pl. 40, figs. 6–7.

*Escharella micropora* Gabb and Horn, p. 242, pl. 40, figs. 8–22, 23.

*Escharella micropora*, var. *asperulata* De Gregorio, p. 242, pl. 40, figs. 21, 22.

*Semieschara tubulata* Gabb and Horn, p. 242, pl. 40, figs. 24–28, 29–31.

*Vincularia (?) insolita* De Gregorio, p. 243, pl. 40, figs. 32–37.

Gregorio, Antonio de—Continued.

- *Lunulites* (*Discoflustrellaria*) *bouci* Lea, p. 243, pl. 41, figs. 1–4. 5–6, 7–9: pl. 42. figs. 1–6.
  - var. *concava* De Gregorio, p. 244, pl. 41, figs. 10–14.
  - var. *depressa* De Gregorio. p. 244, pl. 41, figs. 15–19.
  - var. *ellipsoides* De Gregorio, p. 245, pl. 41, figs. 20–21, 23–25.
  - var. *duclosii* (Lea) De Gregorio, not Gabb and Horn, p. 245, pl. 41, 26–31, 32–33.
  - var. *truncata* De Gregorio. p. 245, pl. 41, figs. 34–46.
  - var. *almina* De Gregorio, p. 246, pl. 42, figs. 7–10.
  - var. *tiza* De Gregorio. p. 246. pl. 42, figs. 11–12.
  - var. *minutecellulata* De Gregorio, p. 246, pl. 42, figs. 13–15.
- *Batopora convivialis* De Gregorio. p. 246, pl. 42, figs. 30–33.
- *Cellepora inornata* Gabb and Horn, p. 247, pl. 43, figs. 2, 3–4.
- *Cellepora cycloris* Gabb and Horn, p. 247, pl. 43, fig. 1.
- *Celleporaria figula* De Gregorio, p. 247, pl. 43, figs. 5–6.
- *Biflustra* (?) *supradubia* De Gregorio, p. 248, pl. 43, figs. 11, 12.
- *Membranipora simplex* De Gregorio, p. 248, pl. 43, figs. 7–8.
- *Membranipora contemplata* De Gregorio, p. 248, pl. 43, figs. 9–10.
- *Dimiclausa* De Gregorio, new subgenus, p. 248.
- *Lunulites* (*Dimiclausa*) *fenestrata* De Gregorio, p. 249, pl. 42, figs. 23–27.
- *Lunulites* (*Cupularia*) *interstitia* (Lea) De Gregorio, p. 249, pl. 42, figs. 16–21. 22.
- *Cupularia discoidea* Lea, species, p. 249. pl. 42, fig. 28.
- *Lunulites distans* Lonsdale, species dubious, p. 250, pl. 42, fig. 29.

1901.

Ulrich, E. O. Maryland Geological Survey, Eocene (Bryozoa, pp. 205–222. Pls. 59, 60. Describes the following species, all from the base of the Aquia formation at Upper Marlboro, Maryland:

- *Discosparsa varians*, new species, p. 205, pl. 61, fig. 3.
- *Fascipora subramosa*, new species, p. 207, pl. 59, figs. 1, 2.
- *Reticulipora dichotoma* Gabb and Horn, p. 207, pl. 59, figs. 9–12.
- *Cavaria dumosa*, new species, p. 208, pl. 59, figs. 4–8.
- *Ceriopora micropora* Goldfuss, p. 210, pl. 59, figs. 13, 14.
- *Heteropora ? tecta*, new species, p. 210, pl. 59, figs. 15, 16.
- *Membranipora rimulata*, new species, p. 211, pl. 60, figs. 1, 2.
- *Membranipora spiculosa*, new species, p. 212, pl. 60, figs. 3, 4.
- *Membranipola angusta*, new species, p. 213, pl. 60. figs. 5, 6.
- *Reptoflustrella heteropora* Gabb and Horn, p. 213, pl. 60, figs. 8, 9.
- *Biflustra torta* Gabb and Horn, p. 214, pl. 60, fig. 7.
- *Eschara ?? digitata* Morton, p. 216, pl. 60, figs. 10, 11.
- *Lunulites reversa*, new species, p. 217, pl. 60, figs. 19, 20.
- *Cribrilina modesta*, new species, p. 218, pl. 60, figs. 12, 13.
- *Cribrilina crassula*, new species, p. 218, pl. 60, fig. 14.
- *Lepralia subplana*, new species, p. 219, pl. 59, figs. 17, 18.
- *Lepralia labiosa*, new species, p. 220, pl. 60, figs. 15, 16.
- *Mucronella aspera*, new species, p. 221, pl. 60, figs. 17, 18.

1917.

CANU, FERDINAND, and BASSLER, RAY S. A Synopsis of American Early Tertiary Cheilostome Bryozoa. Bulletin 96 U. S. National Museum, 87 pp., 6 pls. Present a classification and describe the following new genera and the genotype of each whenever the species is new:

*Acanthocella, Acanthionella, Adenifera, Aechmella, Bathosella, Cribrendoecium, Cystisella, Dacryonella, Didymosella, Diplopholeos, Enoplostomella, Floridinella, Gastropella, Hippadenelta, Hippellozoon, Hippomenella, Hippozeugoselta, Kleidionella, Kymella, Leiosella, Membraniporidra, Membrendoecium, Metracolposa, Metradolium, Metrocrypta, Metroperiella, Ochetosella, Odontionella, Ogivalina, Otionella, Perigastrella, Plagiosmittia, Periporosella, Rectonychocella, Shizaropsis, Schizellozoon, Schizemiella, Schizobathysella, Schizomavella, Schizopodrella, Schizorthosecos, Semihaswellia, Stamenocella, Stephanosella, Stomachetosella, Tremotoichos, Triphyltozoon, Tubucella, Velumella, Vibracellina.*

## SYNONYMIC REFERENCES.

The following alphabetic list gives the present position of all the North American early Tertiary bryozoa described previously to 1917. This list supplements the chronological catalogue of papers printed on pages 7 to 10. By comparison with this catalogue it will be noted that the larger part of the old species has been identified, with the exception of those contained in the work of De Gregorio, 1890. This author's descriptions and illustrations are so poor and his localities so indefinite that in the majority of cases it has been impossible to consider his species as recognizable.

### REFERENCES OF PREVIOUSLY DESCRIBED NORTH AMERICAN EARLY TERTIARY BRYOZOA.

*Batopora conviralis* De Gregorio, 1890. Not recognized.
*Biflustra* (?) *supradubia* De Gregorio, 1890. Not recognized.
*Biflustra torta* Gabb and Horn, 1862. See *Euritina torta*.
*Cavaria dumosa* Ulrich, 1901. See *Partretocycloecia dumosa*.
*Cellepora cycloris* Gabb and Horn, 1862. See *Perigastrella cycloris*.
*Cellepora inornata* Gabb and Horn, 1862. See *Trypostega inornata*.
*Celleporaria figula* De Gregorio, 1890. Not recognized.
*Cribrilina crassula* Ulrich, 1901. See *Membraniporella crassula*.
*Cribrilina modesta* Ulrich, 1901. See *Membraniporella modesta*.
*Crisia laeta* De Gregorio. Not recognizable.
*Cupularia discoidea* Lea. Not recognized.
*Discoflustrellaria bouei* Gabb and Horn, 1862. See *Trochopora bouei*.
*Discosparsa varians* Ulrich, 1901. See *Diaperoecia varians*.
*Entalophora amoena* De Gregorio, 1890. See *Heteropora amoena*.
*Entalophora proboscidoides* Gabb and Horn, 1862. Possibly *Mecynoecia proboscidea*.
*Eschara digitata* Morton, 1834. See *Coscinopleura digitata*.
*Eschara incumbens* Lonsdale, 1845. See *Schizopodrella viminea*.
*Eschara linea* Lonsdale, 1845. See *Schizopodrella linea*.
*Eschara ovalis* Gabb and Horn, 1862. Not recognized.
*Eschara petiolus* Lonsdale, 1845. See *Hippodiplosella petiolus*.
*Eschara spongiopsis* De Gregorio, 1890. See *Cyclicopora spongiopsis*.
*Eschara texta* Gabb and Horn, 1862. See *Schizopodrella viminea*.
*Eschara tubulata* Lonsdale, 1845. See *Smittina tubulata*.
*Eschara viminea* Lonsdale, 1845. See *Schizopodrella viminea*.

*Escharella micropora* De Gregorio, 1890. Probably *Metrarabdotos monilifera.*
*Escharella micropora*, var. *asperulata* De Gregorio, 1890. Not recognizable.
*Escharella sifra* De Gregorio. Not recognizable.
*Escharinella* (?) *linea* Gabb and Horn, 1862. See *Schizopodrella linea.*
*Fascipora subramosa* Ulrich, 1901. See *Plagioecia subramosa.*
*Heteractis duclosii* Gabb and Horn, 1862. See *Trochopora bouei.*
*Heteropora attenuata* Ulrich, 1882. See *Tretocycloecia attenuata.*
*Heteropora consimilis* Ulrich, 1882. See *Parascosoecia consimilis.*
*Hippothoa tuberculum* Lonsdale, 1845. See *Pyripora tuberculum.*
*Hornera claibornensis* De Gregorio. Not recognized.
*Hornera mirifica* De Gregorio. Not recognizable.
*Hornera multiramosa* De Gregorio. Not recognizable.
*Idmonea commiscens* Lonsdale, 1845. Not recognized.
*Idmonea maxillaris* Lonsdale, 1845. See *Idmidronea maxillaris.*
*Idmonea subdisticha* De Gregorio. Not recognizable.
*Lepralia labiosa* Ulrich, 1901. See *Cheilopora labiosa.*
*Lepralia subplana* Ulrich, 1901. See *Meniscopora subplana.*
*Lunulites bouei* Lea, 1833. See *Trochopora bouei.*
*Lunulites* (*Discoflustrellaria*) *bouei* De Gregorio, 1890. See *Trochopora bouei.*
*Lunulites* (*Discoflustrellaria*) *bouei*, var. *almina* De Gregorio, 1890. See *Trochopora bouei.*
*Lunulites* (*Discoflustrellaria*) *bouei*, var. *concava* De Gregorio, 1890. See *Trochopora bouei.*
*Lunulites* (*Discoflustrellaria*) *bouei*, var. *depressa* De Gregorio, 1890. See *Trochopora bouei.*
*Lunulites* (*Discoflustrellaria*) *bouei*, var. *duclosii* De Gregorio, 1890. See *Trochopora bouei*
*Lunulites* (*Discoflustrellaria*) *bouei*, var. *ellipsoides* De Gregorio, 1890. See *Trochopora bouei.*
*Lunulites* (*Discoflustrellaria*) *bouei*, var. *minutecellulata* De Gregorio, 1890. Not recognized.
*Lunulites* (*Discoflustrellaria*) *bouei*, var. *tiza* De Gregorio, 1890. See *Trochopora bouei.*
*Lunulites* (*Discoflustrellaria*) *bouei*, var. *truncata* De Gregorio, 1890. See *Trochopora truncata.*
*Lunulites contigua* Lonsdale, 1845. See *Lunularia contigua.*
*Lunulites distans* Lonsdale, 1845. . See *Lunularia distans.*
*Lunulites duclosii* Lea, 1833. See *Trochopora bouei* Lea, 1833.
*Lunulites* (*Dimiclausa*) *fenestrata* De Gregorio, 1890. See *Lunularia fenestrata.*
*Lunulites interstitia* Gabb and Horn, 1862. See *Schizorthosecos interstitia.*
*Lunulites* (*Cupularia*) *interstitia* De Gregorio, 1890. See *Schizorthosecos interstitia.*
*Lunulites reversa* Ulrich, 1901. See *Lunularia reversa.*
*Lunulites sexangula* Lonsdale, 1845. Not recognized.
*Lunulites vicksburgensis* Conrad, 1847. See *Lunularia* (*Oligotresium*) *vicksburgensis.*
*Membranipora angusta* Ulrich, 1901. See *Ellisina angusta.*
*Membranipora contemplata* De Gregorio, 1890. Not recognizable.
*Membranipora rimulata* Ulrich, 1901. See *Membraniporina rimulata.*
*Membranipora simplex* De Gregorio, 1890. Not recognizable.
*Membranipora spiculosa* Ulrich, 1901. See *Ellisina spiculosa.*
*Myriozoum fervens* De Gregorio, 1890. Not recognizable.
*Myriozoum propepunctatum* De Gregorio, 1890. Not recognizable.
*Mucronella aspera* Ulrich, 1901. See *Bathosella aspera.*
*Oligotresium vicksburgensis* Gabb and Horn, 1862. See *Lunularia* (*Oligotresium*) *vicksburgensis.*
*Onychocella digitata* Weller. See *Coscinopleura digitata.*
*Orbitolites discoidea* Lea, 1833. Not recognizable.
*Orbitolites interstitia* Lea, 1833. See *Schizorthosecos interstitia.*
*Pyriflustrella tuberculum* Gabb and Horn, 1862. See *Pyripora tuberculum.*
*Reptocelleporaria glomerata* Gabb and Horn, 1862. See *Osthimosia glomerata.*
*Reptescharella carolinensis* Gabb and Horn, 1862. See *Puellina radiata carolinensis.*
*Reptoflustrella heteropora* Gabb and Horn, 1862. See *Amphiblestrum heteropora.*

*Reptescharellina disparilis* Gabb and Horn, 1862. See *Micropora coriacea.*
*Reticulipora dichotoma* Gabb and Horn, 1862. See *Lekythionia dichotoma.*
*Semieschara tubulata* Gabb and Horn, 1862. See *Smittina tubulata.*
*Tubulipora proboscidea* Lonsdale, 1845. Probably *Mecynoecia proboscidea.*
*Vincularia (?) insolita* De Gregorio, 1890. Not recognizable.

## GEOLOGIC TABLES OF MESOZOIC AND CENOZOIC FORMATIONS.

The following tables are introduced for convenience of reference in the location of the various formational names employed in this monograph.

*Table showing relations of Early Tertiary formations of Atlantic and Gulf States.*

| Series. | Group. | North Carolina. | South Carolina. | East Georgia. | West Georgia. | Florida. | Alabama. | Mississippi. |
|---|---|---|---|---|---|---|---|---|
| Oligocene. | Vicksburgian. | (Absent).... | (Absent)...... | (Absent).... | Vicksburg group (undifferentiated). | Marianna limestone. | Marianna limestone (with Glendon limestone member.)<br>Red Bluff clay. | Byram marl.<br>Marianna limestone (with Glendon limestone and Mint Spring calcareous marl member).<br>Red Bluff clay. |
| Eocene. | Jacksonian. | Castle Hayne limestone. | Cooper marl, Barnwell formation. | Barnwell formation. | Ocala limestone (Tivola tongue at base). | Ocala limestone. | Ocala limestone (east of Tombigbee river).<br>Jackson formation (west of Tombigbee river). | Jackson formation (with Yazoo clay and Moodys marl members). |
| | Claibornian. | Trent marl.. | McBean formation. | McBean formation. | Undifferentiated. | (Buried).... | Gosport sand,<br>Lisbon formation,<br>Tallahatta buhrstone. | Yegua formation,<br>Lisbon formation,<br>Tallahatta buhrstone. |
| | Wilcoxian. | (Absent).... | Congaree shales,<br>Williamsburg formation. | (Probably overlapped). | Wilcox formation. | (Buried).... | Hatchetigbee formation, Bashi formation, Tuscahome formation, Nanafalia formation, | Grenada formation,<br>Holly Spring sand<br>Ackerman formation. |
| | Midwayan. | (Absent).... | Black Mingo formation. | (Probably overlapped). | Midway formation. | (Buried).... | Naheola formation,<br>Sucharnachee clay.<br>Clayton limestone. | Tippahsandstone.<br>Porters Creek clay.<br>Clayton limestone absent or replaced by sand. |

The above table shows the general relations of the early Tertiary formations of North America, most of which have yielded bryozoan remains. The following table gives a summary of the principal European and South American post Paleozoic divisions. An index of these divisions is also introduced for the convenience of the student.

SUBDIVISIONS OF EUROPEAN AND SOUTH AMERICAN MESOZOIC AND CENOZOIC ROCKS.

| EUROPE. | | | | ARGENTINA. |
|---|---|---|---|---|
| Cenozoic. | Quaternary. | Recent.<br>Pleistocene. | | Post-pampian. |
| | Tertiary. | Pliocene. | Sicilian.<br>Astian (Red Crag).<br>Plaisancian (Coralline Crag. | Pampian. |
| | | Miocene. | Pontian (Anversian) } Zanclean.<br>Sarmatian (Sahelian) }<br>Tortonian.<br>Helvetian.<br>Burdigalian (Langhian).<br>Aquitanian. | Araucanian.<br>Patagonian. |
| | | Oligocene. | Tongrian { Chattian (Casselian).<br>Rupelian (Stampian).<br>Latdorfian (Sannoisian, Ligurian). | Enterrian.<br>Magellanian. |
| | | Eocene. | Ludian } Priabonian.<br>Bartonian }<br>Auversian.<br>Lutetian (Parisian).<br>Soissonian { Ypresian (Londinian).<br>(Suessonian) { Sparnacian (Landenian, part).<br>Thanetian (Landenian, part).<br>Montian (Garumnian). | Santa-cruzian. |
| Mesozoic. | Cretaceous. | Upper Cretaceous. | Danian.<br>Senonian { Maastrichtian } Upper Chalk.<br>Campanian<br>Santonian.<br>Coniacian.<br>Turonian (Middle Chalk).<br>Cenomanian { Lower Chalk.<br>Upper Greensand. | (Rocanean.)<br>Guaranian. |
| | | Lower Cretaceous. | Albian (Gault).<br>Aptian (Lower Greensand).<br>Barrêmian (Urgonian).<br>Neocomian (Wealden). | Chubutian. |
| | Jurassic. | Upper Jurassic (Malm). | Portlandian.<br>Kimmeridgian.<br>Sequanian.<br>Oxfordian.<br>Callovian. | |
| | | Middle Jurassic (Dogger). | Bathonian (Great Oolite, etc.).<br>Bajocian (Inferior Oolite). | |
| | | Lower Jurassic (Lias). | Toarcian.<br>Charmouthian.<br>Sinemurian.<br>Hettangian.<br>Rhaetian. | |
| | Triassic. | Upper Triassic (Keuper). | Juvavian.<br>Norian.<br>Carinthian. | |
| | | Middle Triassic (Muschelkalk). | Ladinian (Tyrolian).<br>Virglorian (Anisian, Dinarian). | |
| | | Lower Triassic (Bunter). | Werfenian (Scythian). | |

## LIST OF MESOZOIC AND CENOZOIC FORMATION NAMES.

Ackerman formation. Wilcoxian.
Albian. Lower Cretaceous.
Anversian. Miocene.
Anisian. Middle Triassic.
Aptian. Lower Cretaceous.
Aquitanian. Miocene.
Araucanian. Miocene.
Astian (Red Crag). Pliocene.
Auversian. Eocene.
Bajocian. Middle Jurassic.
Barnwell formation. Jacksonian.
Barrêmian. Lower Cretaceous.
Bartonian. Eocene.
Bashi formation. Wilcoxian.
Bathonian. Middle Jurassic.
Black Mingo formation. Midwayan.
Burdigalian. Miocene.
Byram marl. Vicksburgian.
Callovian. Upper Jurassic.
Campanian. Upper Cretaceous.
Carinthian. Upper Triassic.
Casselian. Oligocene.
Castle Hayne limestone. Jacksonian.
Cenomanian. Upper Cretaceous.
Charmouthian. Lower Jurassic.
Chattian. Oligocene.
Chubutian. Lower Cretaceous.
Clayton limestone. Midwayan.
Coniacian. Upper Cretaceous.
Congaree shales. Wilcoxian.
Cooper marl. Jacksonian.
Coralline Crag. Pliocene.
Danian. Upper Cretaceous.
Dinarian. Middle Triassic.
Euterrian. Oligocene.
Garumnian. Eocene.
Gault. Lower Cretaceous.
Glendon limestone member. Vicksburgian.
Gosport sand. Claibornian.
Great Oolite. Middle Jurassic.
Grenada formation. Wilcoxian.
Guaranian. Upper Cretaceous.
Hatchetigbee formation. Wilcoxian.
Helvetian. Miocene.
Hettangian. Lower Jurassic.
Holly Spring sand. Wilcoxian.
Inferior Oolite. Middle Jurassic.
Jackson formation. Jacksonian.
Juvavian. Upper Triassic.
Kimmeridgian. Upper Jurassic.
Ladinian. Middle Triassic.
Landenian. Eocene.
Langhian. Miocene.
Latdorfian. Oligocene.
Ligurian. Oligocene.
Lisbon formation. Claibornian.
Londinian. Eocene.
Lower Chalk. Upper Cretaceous.
Lower Greensand. Lower Cretaceous.
Ludian. Eocene.
Lutetian. Eocene.
Maastrichtian. Upper Cretaceous.
Magellanian. Oligocene.
Marianna limestone. Vicksburgian.
McBean formation. Claibornian.
Middle Chalk. Upper Cretaceous.
Midway formation. Midwayan.
Mint Spring calcareous marl member. Vicksburgian.
Montian. Eocene.
Moodys marl member. Jacksonian.
Naheola formation. Midwayan.
Nanafalia formation. Wilcoxian.
Neocomian. Lower Cretaceous.
Norian. Upper Triassic.
Ocala limestone. Jacksonian.
Oxfordian. Upper Jurassic.
Pampian. Pliocene.
Parisian. Eocene.
Patagonian. Miocene.
Plaisancian. Pliocene.
Pontian. Miocene.
Porters Creek clay. Midwayan.
Portlandian. Upper Jurassic.
Post-pampian. Pleistocene.
Priabonian. Eocene.
Red Bluff clay. Vicksburgian.
Red Crag. Pliocene.
Rhaetian. Lower Jurassic.
Rocanean. Upper Cretaceous, Eocene.
Rupelian. Oligocene.
Sahelian. Miocene.
Sannoisian. Oligocene.
Santa-cruzian. Eocene.
Santonian. Upper Cretaceous.
Sarmatian. Miocene.
Scythian. Lower Triassic.
Senonian. Upper Cretaceous.
Sequanian. Upper Jurassic.
Sicilian. Pliocene.
Sinemurian. Lower Jurassic.
Soissonian (Suessonian). Eocene.
Sparnacian. Eocene.
Stampian. Oligocene.
Sucharnachee clay. Midwayan.
Suessonian. Eocene.
Tallahatta buhrstone. Claibornian.
Thanetian. Eocene.
Tippah sandstone. Midwayan.
Tivola tongue of Ocala limestone. Jacksonian.
Toarcian. Lower Jurassic.
Tongrian. Oligocene.
Tortonian. Miocene.
Trent marl. Claibornian.
Turonian. Upper Cretaceous.
Tuscahome formation. Wilcoxian.
Tyrolian. Middle Triassic.
Upper Chalk. Upper Cretaceous.
Upper Greensand. Upper Cretaceous.
Urgonian. Lower Cretaceous.
Virglorian. Middle Triassic.
Wealden. Lower Cretaceous.
Werfenian. Lower Triassic.
Wilcox formation. Wilcoxian.
Williamsburg formation. Wilcoxian.
Yazoo clay. Jacksonian.
Yegua formation. Claibornian.
Ypresian. Eocene.
Zanclean. Miocene.

## LIST OF LOCALITIES WITH FORMATIONS AND STATION NUMBERS.

The following list includes all of the localities from which the bryozoa described in this volume have been obtained. Its purpose, in addition to showing the geologic and geographic distribution of the former, is to cite the station numbers of the collections under which, in the records of the United States Geological Survey, full stratigraphic data are given.

### LOWEST EOCENE.

Upper Marlboro, Maryland. Bryozoan bed at base of Aquia formation.

### MIDWAYAN.

Well near depot at Brundidge, Alabama. Clayton limestone.

Old limekiln on south edge of Luverne, Crenshaw County, Alabama. Clayton limestone. Station No. 6760, United States Geological Survey.

Conochechebee Creek, 1 mile north of Fort Gaines, Georgia, Clayton limestone.

Three miles north of Scooba, Kemper County, Mississippi. Porters Creek clay. Station No. 6760, United States Geological Survey.

Bluff on south side of Owl Creek, 2¾ miles northeast of Ripley, Tippah County, Mississippi. Clayton limestone. Station No. 6497, United States Geological Survey.

Mabelvale, near Little Rock, Arkansas. Clayton limestone.

### WILCOXIAN.

Woods Bluff, Alabama. Bashi formation.

### CLAIBORNIAN.

Claiborne, Alabama. Gosport sand.

One mile southwest of Rockville, Clarke County, Alabama. Gosport sand. Station No. 6158, United States Geological Survey.

Wautubbee Hills, 4 miles south of Enterprise, Clarke County, Mississippi. Lisbon formation. Station No. 2616, United States Geological Survey.

Moseleys Ferry, Caldwell County, Texas. Cook Mountain formation. Station No. 5473, United States Geological Survey.

Gopher Hill, Tombigbee River, Alabama. Gosport sand.

### JACKSONIAN.

Will Scott spring, 3½ miles southeast Shell Bluff Post Office, Georgia Base of Barnwell formation.

Two and one-half miles north of Robert, Mississippi. Moodys marl member of lower Jacksonian.

Shubuta, Mississippi. Station No. 7376*b*. United States Geological Survey. Zeuglodon zone of Moodys marl. Lower Jacksonian.

Cocoa Post Office, 2½ miles east of Melville, Choctaw County, Alabama. Station No. 7219, United States Geological Survey. Zeuglodon zone of Moodys marl. Lower Jacksonian.

Bluff on south side of Suck Creek, half mile above its mouth, Clarke County, Mississippi. Station No. 7377, United States Geological Survey. Zeuglodon zone of Moodys marl. Lower Jacksonian.

Jackson, Mississippi. Moodys marl member of lower Jacksonian.

Wilmington, North Carolina. Castle Hayne limestone. Middle Jacksonian.

Eutaw Springs, South Carolina. Cooper marl. Middle Jacksonian.

Santee River, 3 miles above Lenuds Ferry, Georgetown County, South Carolina. Cooper marl. Middle Jacksonian.

Baldock, Barnwell County, South Carolina. Ostrea georgiana bed at base of Barnwell formation. Middle Jacksonian.

Rich Hill, 5¼ miles southeast of Knoxville, Crawford County, Georgia. Station No. 3604, United States Geological Survey. Tivola tongue of lower Ocala limestone . Middle Jacksonian.

Pennehatchee creek, 1½ miles northeast of Lily, Dooly County, Georgia. Tivola tongue of lower Ocala limestone. Middle Jacksonian.

One-half mile southeast Georgia Kaolin Company Mine, Twiggs County, Georgia. Tivola tongue of lower Ocala limestone. Middle Jacksonian.

Deese Plantation, 17 miles northeast of Hawkinsville, Georgia. Station No. 2310, United States Geological Survey. Tivola tongue of lower Ocala limestone. Middle Jacksonian.

Three and one-fourth miles south of Perry, Georgia. Tivola tongue of lower Ocala limestone. Middle Jacksonian.

Brooks Farm, 12 miles southeast of Marshallville, Georgia. Station No. 3996, United States Geological Survey. Tivola tongue of lower Ocala limestone. Middle Jacksonian.

Wing Jaw Bluff on Oconee River, 18 miles west of Wrightsville, Johnson County, Georgia. Station No. 5539, United States Geological Survey. Tivola tongue of lower Ocala limestone. Middle Jacksonian.

Three and one-half miles north of Grovania, Georgia. Tivola tongue of lower Ocala limestone. Middle Jacksonian.

Near Plant System Railroad Wharf, Bainbridge, Georgia. Station No. 3390, United States Geological Survey. Top of Ocala limestone. Upper Jacksonian.

Flint River, Old Factory, 1½ miles above Bainbridge, Georgia. Station No. 7097, United States Geological Survey. Top of Ocala limestone. Upper Jacksonian.

Red Bluff on Flint River, 7 miles above Bainbridge, Georgia. Station No. 3387, United States Geological Survey. Top of Ocala limestone. Upper Jacksonian.

Flint River, 4 miles below Bainbridge, Georgia. Top of Ocala limestone. Upper Jacksonian.

Steamboat Point on West Bank Sepulga River, Escambia County, Alabama. Station No. 6747, United States Geological Survey. Top of Ocala limestone. Upper Jacksonian.

Alachua, Florida. Station No. 6790, United States Geological Survey. Upper part of Ocala limestone. Upper Jacksonian.

Ocala, Florida. Upper part of Ocala limestone. Upper Jacksonian.

West Bank of Chipola River, east of Marianna, Jackson County, Florida. Station No. 6768, United States Geological Survey. Upper part of Ocala limestone. Upper Jacksonian.

### VICKSBURGIAN.

Red Bluff, Wayne County, Mississippi. Red Bluff clay.

Seven and one-half miles southwest of Bladon Springs, Alabama. Red Bluff clay.

One mile north of Monroeville, Alabama. "Chimney rock" member of Marianna limestone. Station No. 6717, United States Geological Survey.

Murder Creek, east of Castleberry, Conecuh County, Alabama. Marianna limestone.

McGowans Bridge, West Bank Conecuh River, one mile below mouth of Sepulga River, Escambia County, Alabama. Glendon member of Marianna limestone. Station No. 6749, United States Geological Survey.

Salt Mountain, 5 miles south of Jackson, Alabama. Marianna limestone.

Two and one-half miles north of Millry, Washington County, Alabama. Marianna limestone.

Near Claiborne, Monroe County, Alabama. Marianna limestone.

Three miles southeast of Vosburg, Jasper County, Mississippi. Marianna limestone. Station No. 6644, United States Geological Survey.

Well 140 feet deep, Escambia County, Alabama. Marianna limestone.

Vicksburg, Mississippi. Byram marl at top, Marianna limestone below.

Byram, Mississippi. Byram marl.

One-fourth mile west of Woodwards, Wayne County, Mississippi. Byram marl. Station No. 6648, United States Geological Survey.

## LISTS SHOWING GEOGRAPHIC AND GEOLOGIC DISTRIBUTION.

### LOWEST EOCENE (BRYOZOAN BED AT BASE OF AQUIA FORMATION).

### UPPER MARLBORO, MARYLAND.

[v. r.=very rare; r.=rare; v. c.=very common; c.=common.]

CHEILOSTOMATA.

*Membraniporina rimulata* Ulrich, 1901 (v. r.).
*Ellisina spiculosa* Ulrich, 1901 (r.).
*Ellisina* (?) *angusta* Ulrich, 1901 (v. c.).
*Amphiblestrum heteropora* Gabb and Horn, 1862 (r.).
*Ramphonotus laevis*, new species (v. r.).
*Stamenocella cylindrica*, new species (v. r.).
*Lunularia reversa* Ulrich, 1901 (r.).
*Euritina torta* Gabb and Horn, 1862 (r.).
*Coscinopleura digitata* Morton, 1834 (r.).
*Macropora aquiae*, new species (c.).
*Membraniporella modesta* Ulrich, 1901 (r.).
*Membraniporella crassula* Ulrich, 1901 (r.).
*Bathosella aspera* Ulrich, 1901 (r.).
*Cheilopora* (?) *labiosa* Ulrich 1901 (r.).
*Meniscopora subplana* Ulrich, 1901 (c.).
*Acanthionella simplex*, new species (v. r.).

CYCLOSTOMATA.

*Heteropora tecta* Ulrich, 1901 (r.).
*Plagioecia subramosa* Ulrich, 1901 (r.).
*Diaperoecia varians* Ulrich, 1901 (r.).
*Diplosolen compactum*, new species (r.).
*Lekythionia dichotoma* Gabb and Horn, 1862 (r.).
*Partretocycloecia dumosa* Ulrich, 1901 (v. c.).

### MIDWAYAN BRYOZOA.

[v. r.=very rare; r.=rare; v. c.=very common; c.=common.]

| Other occurrences.[1] | List of species. | Brundidge, Alabama, | Luverne, Crenshaw County, Alabama. | 1 mile north of Fort Gaines, Georgia. | 3 miles north of Scooba, Kemper County, Mississippi. | 2¾ miles northeast Ripley, Mississippi. | Mabelvale, near Little Rock, Arkansas. |
|---|---|---|---|---|---|---|---|
| | CTENOSTOMATA. | | | | | | |
| | *Terebripora*, species undetermined | | | | v. r. | | |
| | CHEILOSTOMATA. | | | | | | |
| | *Pyripora parvicella*, new species | r. | | | | | |
| | *Conopeum ornatum*, new species | | | | | | v. r. |
| | *Conopeum damicornis*, new species | | | | | c. | v. r. |
| | *Membraniporina canalifera*, new species | | r. | r. | | | |
| | *Membrendoecium transversum*, new species | | | r. | | | r. |
| | *Callopora sexspinosa*, new species | v. r. | | | | | |
| | *Callopora dumerilli* Audouin, 1826 | v. r. | | | | | |
| | *Callopora stipata*, new species | v. r. | | | | | |
| | *Callopora* (?) *tuberosa*, new species | | | v. r. | | | |

[1] J=Jacksonian. V=Vicksburgian. C=Claibonian.

| Other occurrences. | List of species. | Brundidge, Alabama. | Luverne, Crenshaw County, Alabama. | 1 mile north of Fort Gaines, Georgia. | 3 miles north of Scooba, Kemper County, Mississippi. | 2¼ miles northeast Ripley, Mississippi. | Mabelvale, near Little Rock, Arkansas. |
|---|---|---|---|---|---|---|---|
| | *Amphiblestrum productum*, new species | ........ | r. | v. r. | ........ | ........ | ........ |
| | *Ramphonotus sloani*, new species | r. | ........ | ........ | ........ | ........ | ........ |
| | *Stamenocella midwayanica*, new species | ........ | v. r. | v. r. | ........ | ........ | c. |
| | *Nellia midwayanica*, new species | ........ | r. | v. r. | ........ | r. | v. r. |
| | *Smittipora midwayanica*, new species | ........ | v. r. | r. | ........ | r. | c. |
| J.V. | *Micropora coriacea* Esper, 1791 | ........ | ........ | v. r. | ........ | ........ | ........ |
| | *Micropora minuticella*, new species | ........ | ........ | v. r. | ........ | ........ | ........ |
| | *Euritina tecta*, new species | ........ | ........ | c. | ........ | ........ | c. |
| | *Membraniporella crassicollis*, new species | ........ | ........ | r. | ........ | ........ | r. |
| | *Membraniporella planula*, new species | ........ | r. | ........ | ........ | ........ | r. |
| | *Cribrilina verrucosa*, new species | e. | c. | c. | ........ | ........ | c. |
| | *Cribrilina laticostulatum*, new species | r. | ........ | ........ | ........ | ........ | ........ |
| | *Cribrilina rathbunae*, new species | ........ | ........ | ........ | ........ | ........ | v. r. |
| | *Puellina*, species undetermined | ........ | v. r. | ........ | ........ | ........ | ........ |
| | *Gephyrotes levigatum*, new species | ........ | ........ | r. | ........ | ........ | ........ |
| | *Gephyrotes saillans*, new species | ........ | r. | ........ | ........ | ........ | ........ |
| | *Acropora trita*, new species | ........ | ........ | r. | ........ | ........ | ........ |
| | *Gastropella ventricosa*, Canu and Bassler, 1917 | ........ | r. | e. | ........ | ........ | c. |
| | *Pachytheca stipata*, new species | ........ | c. | ........ | ........ | ........ | ........ |
| | *Beisselina forata*, new species | ........ | ........ | ........ | ........ | ........ | r. |
| | *Beisselina midwayanica*, new species | ........ | r. | r. c. | ........ | ........ | c. |
| | *Hippothoa (?) conjuncta*, new species | ........ | r. | ........ | ........ | ........ | ........ |
| | *Hippoporina midwayanica*, new species | ........ | ........ | r. | ........ | ........ | ........ |
| | *Bathosella cingerans*, new species | ........ | ........ | ........ | ........ | ........ | c. |
| | *Bathosella undata*, new species | ........ | ........ | r. | ........ | ........ | r. |
| | *Anarthropora (?) verrucosa*, new species | ........ | v. r. | r. | ........ | ........ | ........ |
| | *Cystisella midwayanica*, Canu and Bassler, 1917 | ........ | r. | r. | ........ | ........ | ........ |
| | *Galeopsis (?) convexa*, new species | ........ | ........ | r. | ........ | ........ | ........ |
| | CYCLOSTOMATA. | | | | | | |
| | *Stomatopora exigua*, new species | v. r. | ........ | ........ | ........ | ........ | ........ |
| | *Stomatopora opposita*, new species | ........ | ........ | ........ | ........ | ........ | v. r. |
| | *Stomatopora contracta*, new species | v. r. | ........ | ........ | ........ | ........ | ........ |
| | *Proboscina variabilis*, new species | v. r. | ........ | ........ | ........ | ........ | ........ |
| | *Proboscina admota*, new species | ........ | v. r. | c. | ........ | ........ | ........ |
| | *Berenicea palmula*, new species | ........ | ........ | v. r. | ........ | ........ | ........ |
| | *Berenicea undata*, new species | ........ | v. r. | ........ | ........ | ........ | ........ |
| | *Berenicea brevissima*, new species | ........ | ........ | v. r. | ........ | ........ | ........ |
| | *Berenicea stipata*, new species | ........ | v. r. | ........ | ........ | ........ | ........ |
| | *Ceriopora vesiculosa*, new species | ........ | v. r. | c. | ........ | ........ | r. |
| | *Heteropora alveolata*, new species | ........ | ........ | ........ | ........ | ........ | r. |
| | *Plagioecia lobata*, new species | ........ | v. c. | r. | ........ | ........ | ........ |
| | *Plagioecia superposita*, new species | v. r. | ........ | ........ | ........ | ........ | ........ |
| | *Plagioecia clavioedes*, new species | ........ | ........ | v. r. | ........ | ........ | v. r. |
| | *Plagioecia brundidgensis*, new species | v. r. | ........ | ........ | ........ | ........ | ........ |
| | *Diastopora tubaedes*, new species | ........ | v. r. | ........ | ........ | ........ | ........ |
| J. V. | *Mecynoecia proboscidea* Milne-Edwards, 1838 | ........ | ........ | ........ | ........ | ........ | v. c. |
| | *Mecynoecia luvernensis*, new species | ........ | r. | ........ | ........ | ........ | ........ |
| | *Entalophora stipata*, new species | ........ | ........ | ........ | ........ | ........ | v. r. |
| | *Tubulipora midwayanica*, new species | ........ | ........ | v. r. | ........ | ........ | ........ |
| | *Pleuronea fibrosa*, new species | ........ | c. | ........ | ........ | ........ | ........ |
| | *Pleuronea alveolata*, new species | ........ | ........ | c. | ........ | ........ | v. c. |
| | *Idmonea tacta*, new species | ........ | ........ | r. | ........ | ........ | ........ |
| C. J. | *Lichenopora grignonensis* Milne-Edwards, 1838 | ........ | c. | r. | ........ | ........ | ........ |
| | *Tretocycloecia (?) attenuata* Ulrich, , 1882 | ........ | ........ | ........ | ........ | ........ | r. |
| | *Ascosoecia prominens*, new species | ........ | ........ | ........ | ........ | ........ | c. |
| | *Ascosoecia (? Zonopora) ulrichi*, new species | ........ | ........ | ........ | ........ | ........ | r. |
| | *Parascosoecia consimilis* Ulrich, 1882 | ........ | ........ | c. | ........ | ........ | v. e. |

### WILCOXIAN (BASHI), WOODS BLUFF, ALABAMA.

[v. r.=very rare; r.=rare; v. c.=very common; c.=common.]

#### CHEILOSTOMATA.

*Conopeum wilcoxianicum*, new species (c.).
*Conopeum (?) similior*, new species (r).
*Alderina (?) nodulosa*, new species (v. r.)
*Lunularia ovata*, new species (r.).
*Trypostega elongata*, new species (r.).
*Aimulosia clavula*, new species (r.).
*Rhamphostomella simplex*, new species (r.).
*Adeonellopsis porosa*, new species (v. r.).
*Adeonellopsis magniporosa*, new species (c.).

#### CYCLOSTOMATA.

*Plagioecia tubifer*, new species (r.).
*Lagonoecia lamellifera*, new species (c.)

### CLAIBORNIAN BRYOZOA.

[v. r.=very rare; r.=rare; v. c.=very common; c.=common.]

| Other occurrences.[1] | List of species. | Claiborne, Alabama. | 1 mile southwest of Rockville, Alabama. | 4 miles south of Enterprise, Mississippi. | Moseleys Ferry, Caldwell County, Texas. | Gopher Hill, Tombigbee River, Alabama. |
|---|---|---|---|---|---|---|
| | CHEILOSTOMATA. | | | | | |
| J. | *Conopeum lacroixii* Busk, 1852 | | | v. r. | | |
| | *Membraniporina laxa* Reuss, 1869 | | v. r. | | | |
| J. | *Trochopora bouei* Lea, 1833 | v. c. | v. c. | v. r. | v. c. | c. |
| J. | *Trochopora truncata* De Gregorio, 1890 | c. | r. | | v. c. | c. |
| J. | *Otionella perforata* Canu and Bassler, 1917 | c. | c. | r. | | c. |
| J. | *Otionella tuberosa*, new species | | | | r. | |
| | *Vibracellina capillaria* Canu and Bassler, 1917 | | | | r. | |
| | *Lunularia ? grandipora*, new species | | | r. | | |
| J. | *Lunularia ligulata*, new species | | | | v. c. | |
| | *Lunularia (Oligotresium) claibornica*, new species | r. | c. | | | c. |
| | *Schizemiella claibornica* Canu and Bassler, 1917 | r. | r. | | r. | r. |
| J. | *Metradolium sulciferum*, new species | | r. | | | |
| J. | *Ochetosella jacksonica* Canu and Bassler, 1917 | | v. r. | | | r. |
| | *Cheilopora orbifera*, new species | | | | | r. |
| J. | *Adeonellopsis quisenberryae*, new species | | r. | | | r. |
| J. | *Adeonellopsis transversa*, new species | | c. | | | |
| | *Perigastrella ansata*, new species | | r. | | | |
| | *Holoporella orbiculifera*, new species | r. | r. | | | |
| J. | *Holaporella granulosa*, new species | r. | c. | v. c. | | r. |
| J. | *Acanthianella oecioporosa*, new species | c. | c. | | | r. |
| J. | *Kleidionella parasitica*, new species | | | | r. | |
| J. | *Schizorthosecos interstitea* Lea, 1833 | c. | c. | c. | v. r. | r. |
| J. | *Schizorthosecos grandiporosum*, new species | c. | | | | |
| | *Schizorthosecos radiatum*, new species | r. | | v. r. | | |
| J. | *Porella denticulifera*, new species | | r. | | | |
| | CYCLOSTOMATA. | | | | | |
| J. | *Heteropora amoena* De Gregorio, 1890 | | r. | | | |
| | *Entalophora crassa*, new species | | r. | | | |
| V. J. | *Pleuronea subpertusa*, new species | | r. | | | |
| V. J. | *Pleuronea fenestrata* Busk, 1859 | | r. | | | |
| J. | *Lichenopora grignanensis* Milne-Edwards | v. r. | | | | |

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[1] J=Jacksonian. V=Vicksburgian. C=Claibornian

| Other Occurrences.[1] | JACKSONIAN CHEILOSTOMATOUS BRYOZOA.<br>[v. r.=very rare; r.=rare; c.=common; v. c.=very common.] | Jackson, Mississippi. | 2½ miles north of Roberts, Mississippi. | 3¾ miles southeast of Shell Bluff post office, Georgia. | Wilmington, North Carolina. | Eutaw Springs, South Carolina. | Near Lenuds Ferry, South Carolina. | Baldock, Barnwell County, South Carolina. |
|---|---|---|---|---|---|---|---|---|
| | *Electra parvimater*, new species | | r. | | | | | |
| | *Pyripora tuberculum* Lonsdale, 1845 | | | | r. | | | |
| C. | *Conopeum lacroixii* Busk, 1852 | r. | | | | v. r. | | |
| | *Conopeum hoockeri* Haime, 1850 | r. | | | | | | |
| | *Conopeum tuberosum*, new species | | r. | | | | | |
| | *Conopeum concavum*, new species | r. | | | | | | |
| | *Conopeum lamellosum*, new species | c. | c. | | | | | |
| | *Conopeum arborescens*, new species | c. | c. | | | | | |
| | *Membraniporina claviformis*, new species | | | | v. r. | | | |
| | *Membraniporina sinesolum*, new species | | r. | | | | | |
| | *Membraniporina benjamini* Canu and Bassler, 1917 | | | | | | | |
| | *Adenifera inarmata* Canu and Bassler, 1917 | | | | v. r. | | c. | |
| C. | *Trochopora bouei* Lea, 1833 | c. | | r. | | | | |
| C. | *Trochopora truncata* De Gregorio, 1890 | v. c. | | r. | | | | |
| C. | *Otionella perforata* Canu and Bassler, 1917 | v. c. | | | | | | |
| | *Otionella mccalliei*, new species | | | v. r. | | | | |
| C. | *Otionella tuberosa*, new species | v. c. | | | | | | |
| | *Otionella cava*, new species | | | | | | | c. |
| | *Hincksina reptans*, new species | | | | r. | r. | | |
| | *Hincksina smithi*, new species | | | | | v. r. | | |
| | *Hincksina jacksonica*, new species | | | | | | | c. |
| V. | *Hincksina ocalensis*, new species | | | | | | | |
| | *Hincksina parvavicularia*, new species | | | | r. | | | |
| | *Hincksina megavicularia* Canu and Bassler, 1917 | | | | v. r. | | | |
| V. | *Hincksina costulifera*, new species | | | | c. | | v. r. | |
| | *Ogivalina eximipora* Canu and Bassler, 1917 | | | | r. | v. r. | r. | |
| | *Ogivalina elongata*, new species | | | | v. r. | v. r. | c. | |
| | *Ogivalina elongata minor*, new species | r. | | | r. | r. | r. | |
| | *Membrendoecium duplex*, new species | v. r. | | | | | | r. |
| | *Membrendoecium rectum*, new species | | | r. | v. r. | | | |
| | *Membrendoecium pyriforme*, new species | v. r. | | | | | r. | |
| | *Periporosella tantilla* Canu and Bassler, 1917 | | | | c. | r. | r. | |
| | *Ellisina laxa* Canu and Bassler, 1917 | | | | c. | r. | r. | |
| | *Ellisina brevis*, new species | | | | | r. | r. | |
| | *Ellisina profunda* MacGillivray, 1895 | v. r. | | | | | v. r. | |
| | *Grammella crassimarginata* Hincks, 1880 | | | | v. r. | | | |
| | *Grammella transversa* Canu and Bassler, 1917 | | | | r. | v. r. | | |
| V. | *Grammella pusilla*, new species | | | | | | | |
| | *Membraniporidra oecioporosa*, new species | v. r. | | | v. r. | v. r. | | |
| | *Membraniporidra pachymuralis*, new species | | | | r. | | | |
| | *Membraniporidra trigemma*, new species | | | | c. | | | |
| | *Membraniporidra laticella*, new species | | | | v. c. | r. | | |
| | *Membraniporidra porrecta* Canu and Bassler, 1917 | | | | c. | | | r. |
| V. | *Membraniporidra spissimuralis*, new species | r. | | v. c. | | | | r. |
| | *Membraniporidra similis*, new species | | | | | v. r. | c. | |
| | *Membraniporidra pyriformis*, new species | | | | | | | |
| | *Alderina pulcherrima*, new species | v. r. | | | v. r. | | v. r. | |
| | *Alderina lunata*, new species | v. r. | | | | | | |
| | *Alderina crassa*, new species | | | | | v. r. | | |
| | *Callopora dumerilli lata*, new variety | | | | v. r. | | | |
| | *Callopora filoparietis*, new species | r. | | | | | | |
| | *Callopora ingens*, new species | v. r. | | | | | | |
| | *Callopora cucullata*, new species | | | v. r. | | | | |
| | *Callopora crassospina*, new species | | | | r. | | | |
| | *Callopora convexa*, new species | | | | r. | | | |
| | *Callopora aurita* Hincks, 1877 | | | | v. r. | | | |
| | *Callopora tenuirostris* Hincks, 1880 | r. | | | | | | |
| | *Callopora mundula*, new species | r. | | | | | | |
| | *Amphiblestrum biporosum*, new species | | | | | | v. r. | |
| | *Amphiblestrum flammeum*, new species | | | | r. | | | |
| | *Amphiblestrum patens*, new species | | | | | | | |
| | *Amphiblestrum orbiculatum*, new species | | | | | | | |
| | *Ramphonotus baccatus*, new species | | | | v. r. | | | |
| | *Ramphonotus regularis*, new species | | | | c. | | | |
| | *Tegella aculeata*, new species | | | | r. | | | |
| | *Tegella nicklesi*, new species | | | | | v. r. | | |

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[1] C.=Claibornian; V.=Vicksburgian

| Rich Hill, 5¼ miles southeast of Knoxville, Georgia. | 1½ miles northeast of Lilly, Dooly County, Georgia. | ½ mile southeast of Georgia Kaolin Co. Mine, Twiggs County, Georgia. | 17 miles northeast of Hawkinsville, Georgia. | 3¼ miles south of Perry, Georgia. | 12 miles southeast of Marshallville, Georgia. | 18 miles west of Wrightsville, Georgia. | 3½ miles north of Grovania, Georgia. | Bainbridge, Georgia. | 1½ miles above Bainbridge, Georgia. | 7 miles above Bainbridge, Georgia. | 4 miles below Bainbridge, Georgia. | West Bank of Sepulga River, Escambia County, Alabama. | Alachua, Florida. | Ocala, Florida. | Chipola River, east of Marianna, Florida. | Shubuta, Mississippi. | Cocoa post office, Choctaw County, Alabama. | Suck Creek, Clarke County, Mississippi. |
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| Other Occurrences. | JACKSONIAN CHEILOSTOMATOUS BRYOZOA. [v. r.=very rare; r.=rare; e.=common; v. e.=very common.] | Jackson, Mississippi. | 2¼ miles north of Roberts, Mississippi. | 3½ miles southeast of Shell Bluff post office, Georgia. | Wilmington, North Carolina. | Eutaw Springs, South Carolina. | Near Lenuds Ferry, South Carolina. | Baldock, Barnwell County, South Carolina. |
|---|---|---|---|---|---|---|---|---|
|  | *Stamenocella anatina*, new species | v. r. |  |  |  |  |  |  |
|  | *Stamenocella pyriforme*, new species | c. |  |  |  |  |  |  |
|  | *Stamenocella mediaviculifera*, new species |  |  |  | r. |  |  | r. |
| V. | *Stamenocella inferaviculifera*, new species |  |  |  | v. r. |  |  |  |
| V. | *Stamenocella grandis*, new species |  |  |  |  |  |  |  |
|  | *Aetea anguina* Linnaeus, 1758 |  |  |  |  |  |  |  |
|  | *Aetea* cf. *truncata* Landsborough, 1852 |  |  |  | r. |  |  |  |
|  | *Scrupocellaria elliptica* Reuss, 1869 |  |  |  | v. r. |  | v. r. |  |
|  | *Scrupocellaria gracilis* Reuss, 1869 |  |  |  |  |  | v. r. |  |
|  | *Scrupocellaria dubia*, new species |  |  |  |  |  | r. |  |
| V. | *Nellia bifaciata*, new species | v. r. |  |  | r. |  |  |  |
|  | *Nellia concatenata* Canu, 1907 |  |  |  |  |  |  |  |
|  | *Gemellaria prima* Reuss, 1866 |  |  |  |  |  |  |  |
|  | *Onychocella angulosa* Reuss, 1847 |  |  |  | r. |  | r. |  |
|  | *Onychocella celsa*, new species | r. |  |  |  |  |  |  |
|  | *Onychocella georgiana*, new species |  |  | r. |  |  |  |  |
|  | *Onychocella laciniosa*, new species |  |  |  | r. |  | r. |  |
|  | *Onychocella duplicater*, new species |  |  |  | v. r. | c. |  |  |
|  | *Rectonychocella bilamellaria*, new species |  |  |  |  |  |  |  |
|  | *Rectonychocella semiluna*, new species |  |  |  | e. |  |  | r. |
| V. | *Rectonychocella tenuis*, new species | e. |  |  |  |  |  |  |
|  | *Rectonychocella elliptica*, new species |  |  |  |  |  |  |  |
|  | *Velumella levigata*, new species |  |  |  |  |  |  |  |
|  | *Velumella plicata*, new species |  |  |  |  |  |  |  |
|  | *Diplopholeos fusiforme* Canu and Bassler, 1917 |  |  |  | e. |  |  |  |
|  | *Diplopholeos sagittellarium*, new species |  |  |  | e. |  | r. |  |
|  | *Diplopholeos sagittarium*, new species |  |  |  | e. |  |  |  |
|  | *Diplopholeos parvuliporum*, new species |  |  |  | r. |  |  |  |
|  | *Floridina granulosa*, new species | r. |  |  |  |  |  |  |
|  | *Floridina bifoliata*, new species | r. |  |  |  |  |  |  |
|  | *Floridina onydentata*, new species |  |  |  | e. |  |  |  |
| V. | *Floridina antiqua* Smitt, 1873 |  |  |  | e. |  | e. | c. |
|  | *Floridina laguncula*, new species |  |  |  | v. c. |  |  |  |
|  | *Floridina asymmetrica*, new species |  |  |  |  |  |  |  |
|  | *Dacryonella octonaria*, new species |  |  |  | v. c. | r. | e. |  |
|  | *Dacryonella minor*, new species |  |  |  |  |  |  |  |
|  | *Aechmella crassimargo*, new species |  |  |  |  | r. | r. |  |
|  | *Aechmella filimargo* Canu and Bassler, 1917 |  |  |  |  |  |  |  |
| V. | *Micropora coriacea* Esper, 1791 |  |  |  | r. |  |  |  |
| C. | *Lunularia ligulata*, new species | v. c. |  | r. |  |  |  |  |
|  | *Lunularia verrucosa*, new species |  |  |  | v. e. |  |  | r. |
|  | *Lunularia fenestrata* De Gregorio, 1894 | c. |  |  |  |  |  |  |
|  | *Lunularia tubifera*, new species |  |  |  |  |  |  |  |
| V. | *Lunularia distans* Lonsdale, 1845 |  |  |  | c. | c. | e. |  |
|  | *Lunularia contigua* Lonsdale, 1845 |  |  |  | r. |  |  |  |
|  | *Lunularia jacksoniensis*, new species | c. |  |  |  |  |  |  |
|  | *Rhagasostoma minusculum*, new species |  |  |  | v. r. | v. r. |  |  |
|  | *Rhagasostoma levigatum*, new species |  |  |  | v. r. |  |  |  |
|  | *Steganoporella jacksonica*, new species | r. |  |  |  |  |  | v. e. |
|  | *Steganoporella rectangularia*, new species | v. r. |  |  |  |  |  |  |
|  | *Steganoporella incrustans*, new species |  |  |  |  |  |  |  |
|  | *Cellaria strictocella*, new species |  |  |  | r. |  |  |  |
|  | *Cellaria dimorpha*, new species |  |  |  | c. |  |  |  |
|  | *Cellaria bifaciata*, new species |  |  |  | r. |  | r. |  |
|  | *Macropora multilamellosa*, new species |  |  |  | c. | c. | e. |  |
|  | *Quadricellaria (?) laciniosa*, new species |  |  |  | v. r. |  |  |  |
|  | *Quadricellaria (?) burnsi*, new species |  |  |  | v. r. |  |  |  |
|  | *Membraniporella ulrichi*, new species |  |  |  | r. | c. | c. |  |
|  | *Membraniporella bioculata*, new species |  |  |  |  |  | r. |  |
|  | *Membraniporella compressa*, new species |  |  |  |  |  |  |  |
|  | *Membraniporella monilifera*, new species |  |  |  |  | r. | r. |  |
| V. | *Puellina radiata* Moll, 1803 |  |  |  | e. | c. | c. |  |
| V. | *Puellina radiata anaticula*, new species |  |  |  |  |  |  |  |
| V. | *Puellina radiata carolinensis* Gabb and Horn, 1862 |  |  |  |  |  | r. |  |
|  | *Puellina bispinosa*, new species |  |  |  |  |  |  |  |
| V. | *Puellina simulator*, new species |  |  |  |  |  |  |  |

| Rich Hill, 5¼ miles southeast of Knoxville, Georgia. | 1½ miles northeast of Lilly, Dooly County, Georgia. | ½ mile southeast of Georgia Kaolin Co. Mine, Twiggs County, Georgia. | 17 miles northeast of Hawkinsville, Georgia. | 3¼ miles south of Perry, Georgia. | 12 miles southeast of Marshallville, Georgia. | 1½ miles west of Wrightsville, Georgia. | 3½ miles north of Grovania, Georgia. | Bainbridge, Georgia. | 1½ miles above Bainbridge, Georgia. | 7 miles above Bainbridge, Georgia. | 4 miles below Bainbridge, Georgia. | West Bank of Sepulga River, Escambia County, Alabama. | Alachua, Florida. | Ocala, Florida. | Chipola River, east of Marianna, Florida. | Shubuta, Mississippi. | Cocoa post office, Choctaw County, Alabama. | Suck Creek, Clarke County, Mississippi. |
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| Other Occurrences. | JACKSONIAN CHEILOSTOMATOUS BRYOZOA. [v. r.=very rare; r.=rare; c.=common; v. c.=very common.] | Jackson, Mississippi. | 2½ miles north of Roberts, Mississippi. | 3½ miles southeast of Shell Bluff post office, Georgia. | Wilmington, North Carolina. | Eutaw Springs, South Carolina. | Near Lenuds Ferry, South Carolina. | Baldock, Barnwell County, South Carolina. |
|---|---|---|---|---|---|---|---|---|
| | *Distanescharella jacksonica*, new species | | | | | | | |
| | *Gephyrotes convexa*, new species | | | | | | | |
| | *Gephyrotes quadriserialis*, new species | | | | | | | |
| | *Metracolposa brevis*, new species | | | | | | r. | |
| | *Metracolposa grandis*, new species | | | | c. | | c. | |
| | *Metracolposa robusta* Canu and Bassler, 1917 | | | | v. c. | r. | | |
| | *Metracolposa cylindrica*, new species | | | | c. | | v. c. | |
| | *Corbulipora collaris*, new species | | | | | | | |
| | *Acanthocella erinacea* Canu and Bassler, 1917 | | | | r. | | | |
| | *Cribrendoecium tenuicostulatum* Canu and Bassler, 1917 | | | | r. | | | |
| | *Figularia (?) crassicostulata*, new species | | | | | | | |
| | *Gastropella asperula*, new species | | | | r. | | | |
| | *Beisselina trulla*, new species | | | | | | | |
| | *Beisselina implicata*, new species | | | | | | | |
| | *Hippothoa*, ? species | | | | | | | |
| | *Trypostega undulata*, new species | | | | | | | r. |
| | *Trypostega inornata* Gabb and Horn, 1862 | | | | | | | |
| | *Schizopodrella linea* Lonsdale, 1845 | | | | r. | c. | v. c. | |
| | *Schizopodrella marginata*, new species | | | | v. r. | | | |
| | *Schizopodrella viminea* Lonsdale, 1845 | v. c. | | | v. c. | c. | c. | c. |
| | *Lacerna jacksoniensis*, new species | c. | | | | | | |
| | *Lacerna hexagonalis*, new species | | | | | | | |
| | *Buffonella hexagonalis*, new species | | | | r. | | | |
| | *Buffonella rhomboidalis*, new species | | | | v. r. | | | |
| | *Buffonella microstoma*, new species | | | | | | | |
| | *Arthropoma metula*, new species | | | | v. r. | | | |
| | *Schizomavella granulifera*, new species | | | | r. | | | v. c. |
| | *Schizomavella granulosa*, new species | | | | | | | |
| | *Schizomavella elongata*, new species | | | | | | | |
| | *Dakaria brevis*, new species | | | | r. | | | |
| | *Dakaria laxata*, new species | | | | | | | |
| | *Metroperiella albora*, new species | | | | v. r. | | | r. |
| | *Metroperiella grandipora*, new species | | | | r. | | | |
| | *Metroperiella porosa*, new species | | | | c. | | c. | |
| | *Metroperiella biplanata*, new species | | | | v. c. | | | |
| | *Metroperiella acervata*, new species | | | | c. | r. | r. | |
| | *Metroperiella latipora*, new species | | | | | v. r. | | |
| | *Emballotheca laticapitata*, new species | | | | r. | | | |
| | *Tetraplaria tuberculata*, new species | | | | | | | |
| | *Tetraplaria caudifera*, new species | | | | | | | r. |
| V. | *Hippoporina lucens*, new species | | | | | | | |
| | *Hippoporina biporosa*, new species | | | | r. | | | |
| | *Hippoporella multilamellosa*, new species | | | | c. | | | |
| | *Hippomenella rotula*, new species | v. c. | | | | | | |
| | *Hippomenella transversata*, new species | | | | r. | | | |
| | *Hippomenella angustaedes*, new species | | | | r. | | | |
| | *Hippomenella incondita*, new species | | | | | c. | r. | r. |
| | *Hippomenella alifera*, new species | | | | v. c. | | | |
| | *Hippomenella radicata*, new species | c. | | | c. | | | |
| | *Hippomenella punctata*, new species | c. | | | | | | |
| | *Hippomenella ligulata*, new species | | | | c. | r. | c. | |
| | *Hippomenella tuberosa*, new species | | | | v. r. | | | |
| | *Hippomenella axiculata*, new species | | | | r. | r. | | |
| V. | *Hippomenella crassicollis*, new species | | | | | | | |
| | *Hippodiplosia vespertilio*, new species | | | | c. | | c. | |
| | *Hippodiplasia petiolus* Lonsdale, 1845 | | | | | r. | | |
| | *Hippodiplosia falcifera*, new species | | | | v. r. | | | |
| | *Hippozeugosella teges*, new species | | | | | | | |
| | *Hippozeugosella distorta*, new species | | | | | | | |
| | *Hippozeugosella arcuata*, new species | c. | | | | | | |
| | *Hippozeugosella marginata*, new species | v. r. | | | | | | |
| | *Hippozeugosella inflata*, new species | | | | | | | r. |
| | *Hippozeugosella sexordinata*, new species | | | | | | | |
| | *Romancheina parvipunctata*, new species | | | | r. | v. r. | r. | |
| | *Romancheina hexagona*, new species | | | | v. r. | | | |
| | *Peristomella laticella*, new species | r. | | | v. c. | | r. | |

| Rich Hill, 5¼ miles southeast of Knoxville, Georgia. | 1½ miles northeast of Lilly, Dooly County, Georgia. | ½ mile southeast of Georgia Kaolin Co. Mine, Twiggs County, Georgia. | 17 miles northeast of Hawkinsville, Georgia. | 3½ miles south of Perry, Georgia. | 12 miles southeast of Marshallville, Georgia. | 18 miles west of Wrightsville, Georgia. | 3½ miles north of Grovania, Georgia. | Bainbridge, Georgia. | 1½ miles above Bainbridge, Georgia. | 7 miles above Bainbridge, Georgia. | 4 miles below Bainbridge, Georgia. | West Bank of Sepulga River, Escambia County, Alabama. | Alachua, Florida. | Ocala, Florida. | Chipola River, east of Marianna, Florida. | Shubuta, Mississippi. | Cocoa post office, Choctaw County, Alabama. | Suck Creek, Clarke County, Mississippi. |
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| Other Occurrences. | JACKSONIAN CHEILOSTOMATOUS BRYOZOA. [v. r.=very rare; r.=rare; c.=common; v. c.=very common.] | Jackson, Mississippi. | 2½ miles north of Roberts, Mississippi. | 3½ miles southeast of Shell Bluff post office, Georgia. | Wilmington, North Carolina. | Eutaw Springs, South Carolina. | Near Lenuds Ferry, South Carolina. | Baldock, Barnwell County, South Carolina. |
|---|---|---|---|---|---|---|---|---|
| | *Peristomella falcifera*, new species | | | | v. c. | | | |
| | *Houzeauina ornata*, new species | | | | | r. | | v. c. |
| | *Houzeauina callosa*, new species | | | | | | | |
| | *Houzeauina librata*, new species | | | | c. | | v. r. | |
| | *Cyclicopora fissurata*, new species | | | | v. r. | | | |
| | *Cyclicopora laticella*, new species | | | | v. r. | | | |
| | *Metradolium labratulum*, new species | | | | | | | r. |
| | *Metradolium dissimile*, new species | | | | v. c. | r. | c. | |
| | *Metradolium parvirimulatum*, new species | | | | r. | v. c. | c. | c. |
| | *Metradolium transversum*, new species | | | | v. c. | | | |
| | *Metradolium grande*, new species | | | | | r. | v. r. | |
| | *Metradolium conveniens*, new species | | | | v. c. | | | |
| C. | *Metradolium sulciferum*, new species | v. c. | | | | | | |
| | *Metradolium obliquum*, new species | | | | v. c. | | v. c. | |
| | *Metrocrypta bucculenta* Canu and Bassler, 1917 | | | | v. c. | | | |
| | *Ochetosella robusta*, new species | | | | c. | | r. | |
| C. | *Ochetosella jacksonica* Canu and Bassler, 1917 | v. c. | | | v. c. | c. | c. | v. c. |
| | *Smittina collum*, new species | | | | c. | | r. | |
| | *Smittina labiatula*, new species | | | | r. | | | |
| | *Smittina grandifossae*, new species | | | | c. | | | |
| | *Smittina coronata*, new species | | | | r. | | | |
| V. | *Smittina angulata* Reuss, 1865 | c. | | | | | | |
| | *Smittina exigua*, new species | | | | | r. | | r. |
| | *Smittina strombecki* Reuss, 1865 | | | | | | | |
| | *Smittina puncturata*, new species | | | | c. | | | |
| | *Smittina sordida*, new species | | | | | | | |
| | *Smittina orbavicularia*, new species | | | | c. | r. | r. | |
| | *Plagiosmittia regularis* Canu and Bassler, 1917 | | | | c. | | | |
| | *Plagiosmittia porelloides*, new species | | | | v. c. | r. | v. c. | |
| | *Plagiosmittia virgula*, new species | | | | v. c. | | | |
| | *Mucronella patens*, new species | | | | r. | | | |
| | *Mucronella granulosa*, new species | v. r. | | | | | | |
| | *Rhamphostomella brendolensis americana*, new variety | | | | r. | v. r. | | |
| | *Rhamphostomella convexa*, new species | | | | | | r. | |
| | *Porella irregularis*, new species | c. | | | | | | |
| | *Porella granulosa*, new species | v. r. | | | | | | |
| | *Porella coronata*, new species | r. | | | v. r. | | | |
| C. | *Porella denticulifera*, new species | c. | | | | | | |
| | *Porella jacksonica*, new species | v. c. | | | c. | | | r. |
| | *Porella pungens*, new species | c. | | | | | | |
| | *Porella unguiculata*, new species | | | | c. | | | |
| | *Porella planulata*, new species | | | | r. | | r. | |
| | *Porella abdita*, new species | | | | | | | |
| | *Porella obliqua*, new species | | | r. | | | | |
| | *Porella portentosa*, new species | | | | | | | v. c. |
| | *Phoceana (?) simulator*, new species | | | | c. | | | |
| | *Retepora ramosa*, new species | | | | c. | r. | c. | |
| | *Retepora scutulata*, new species | | | | | | | |
| | *Galeopsis longicollis*, new species | | | | v. r. | | | |
| | *Galeopsis verrucosa*, new species | | | | r. | | | |
| | *Galeopsis erinaceus*, new species | | | | r. | | | |
| | *Galeopsis cyclops*, new species | | | | | | | |
| | *Schizaropsis convexus* Canu and Bassler, 1917 | r. | | | | | | |
| | *Haswellia gracilis*, new species | | | | v. c. | | | |
| | *Semihaswellia tripora*, new species | | | | | | r. | |
| V. | *Semihaswellia exilis*, new species | | | | | | | |
| | *Semihaswellia (?) clara*, new species | | | | | | r. | |
| | *Gigantopora filiformis*, new species | | | | | | | |
| | *Tessaradoma ornata*, new species | | | | v. r. | | | |
| | *Tessaradoma grandipora*, new species | | | | | | | |
| | *Tremotoichos rectifurcatum* Canu and Bassler, 1917 | | | | v. c. | | v. c. | |
| | *Cheilopora prelucidoides*, new species | | | | | | r. | |
| | *Cheilopora strictocella*, new species | | | | | | v. r. | v. r. |
| | *Cheilopora grandis*, new species | | | | c. | | | |
| | *Cheilopora saillans*, new species | | | | c. | | | |
| | *Cheilopora transversa*, new species | | | | c. | | r. | |

| Rich Hill, 5¼ miles southeast of Knoxville, Georgia. | 1½ miles northeast of Lilly, Dooly County, Georgia. | ½ mile southeast of Georgia Kaolin Co. Mine, Twiggs County, Georgia. | 17 miles northeast of Hawkinsville, Georgia. | 3¼ miles south of Perry, Georgia. | 12 miles southeast of Marshallville, Georgia. | 18 miles west of Wrightsville, Georgia. | 3½ miles north of Grovania, Georgia. | Bainbridge, Georgia. | 1½ miles above Bainbridge, Georgia. | 7 miles above Bainbridge, Georgia. | 4 miles below Bainbridge, Georgia. | West Bank of Sepulga River, Escambia County, Alabama. | Alachua, Florida. | Ocala, Florida. | Chipola River, east of Marianna, Florida. | Shubuta, Mississippi. | Cocoa post office, Choctaw County, Alabama. | Suck Creek, Clarke County, Mississippi |
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| Other Occurrences. | JACKSONIAN CHEILOSTOMATOUS BRYOZOA. [v. r.=very rare; r.=rare; c.=common; v. c.=very common.] | Jackson, Mississippi. | 2¼ miles north of Roberts, Mississippi. | 3½ miles southeast of Shell Bluff post office, Georgia. | Wilmington, North Carolina. | Eutaw Springs, South Carolina. | Near Lenuds Ferry, South Carolina. | Baldock, Barnwell County, South Carolina. |
|---|---|---|---|---|---|---|---|---|
| | *Cheilopora transversoides*, new species | | | | r. | | c. | |
| | *Cheilopora specula*, new species | | | | c. | | | |
| | *Cheilopora sulcifera*, new species | | | | r. | | | |
| | *Hippopodina vibraculifera* Canu and Bassler, 1917 | | | | c. | | | |
| | *Watersipora (?) erecta*, new species | | | | | | | |
| | *Tubucellaria parviporosa*, new species | | | | | | | c. |
| | *Tubucellaria fallax*, new species | | | | | | | |
| | *Tubucellaria nodifera*, new species | | | | | | | |
| | *Tubucella monilifera*, new species | | | | c. | r. | | |
| | *Tubucella gibbosa*, new species | | | | | | c. | |
| | *Bracebridgia aculeata*, new species | | | | | | | |
| | *Bracebridgia polymorpha costulata*, new variety | | | | | | | |
| | *Adeonella folliculata* Canu and Bassler, 1917 | | | | c. | | | |
| C. | *Adeonellopsis quisenberryae*, new species | r. | | | | | | |
| C. | *Adeonellopsis transversa*, new species | r. | | | | | | |
| | *Phylactella infundibulum*, new species | | | | r. | | | |
| | *Phylactella parvicollum*, new species | | | | r. | | | |
| | *Phylactella parvicella*, new species | | | | | | | v. r. |
| | *Perigastrella hexagonalis*, new species | | | | r. | | | |
| | *Perigastrella rhomboidalis*, new species | | | | v. r. | | | |
| | *Perigastrella cycloris* Gabb and Horn, 1867 | | | | c. | | v. r. | |
| | *Perigastrella oscitans*, new species | v. | | | c. | r. | | |
| | *Perigastrella elegans*, new species | | | | | | | r. |
| V. | *Perigastrella ovoidea* Canu and Bassler, 1917 | | | | | c. | | |
| | *Perigastrella maxilla*, new species | | | | | | | |
| | *Perigastrella trapezoidea*, new species | | | | c. | | c. | |
| | *Perigastrella depressa*, new species | | | | c. | | r. | |
| V. | *Perigastrella rectilineata*, new species | r. | | | c. | | | |
| | *Perigastrella? tubulosa*, new species | | | | | | | |
| | *Hemicyclopora parajuncta* Canu and Bassler, 1917 | | | | | | c. | |
| V. | *Mastigophora hyndmani* Johnston, 1847 | r. | | | | | | |
| V. | *Mastigophora dutertrei* Savigny-Audouin, 1826 | | | | | | | |
| | *Schizobathysella semilunata*, new species | | | | v. | | | |
| | *Schizobathysella saccifera* Canu and Bassler, 1917 | | | | r. | | | |
| V. | *Lagenipora americana*, new species | | | | v. r. | | | |
| | *Schismopora globosa*, new species | c. | | | | | | |
| | *Schismopora umbonata*, new species | | | | | | | |
| | *Schismopora orbicularis*, new species | | | | | | | |
| V. | *Osthimosia glomerata* Gabb and Horn, 1862 | v. c. | | | c. | | | |
| V. | *Holoporella fissurata*, new species | c. | | | | | | |
| | *Holoporella altirostris*, new species | | | | c. | | | |
| C. | *Holoporella granulosa*, new species | c. | | | | | | |
| | *Holoporella crassicollis*, new species | | | | r. | | | |
| | *Holoporella pisiformis*, new species | | | | c. | | | |
| | *Holoporella damicornis*, new species | v. r. | | | | | | |
| | *Holoporella separata*, new species | | | | | | | v. c. |
| | *Holoporella micropora*, new species | | | | | | | |
| | *Holoporella birostrata*, new species | | | | r. | | | |
| C. | *Acanthionella occioporosa*, new species | c. | | | | | | |
| V. | *Kleidionella grandis* Canu and Bassler, 1917 | c. | c. | | c. | | | |
| C. | *Kleidionella parasitica*, new species | | | c. | | | | |
| | *Kleidionella lobata*, new species | | | | v. c. | r. | c. | r. |
| | *Kleidionella cristata*, new species | | | | | | v. c. | |
| | *Stichoporina protecta* Koschinski, 1885 | | | | c. | | | |
| C. | *Schizorthosecos interstitea* Lea, 1833 | v. c. | | r. | | | | |
| C. | *Schizorthosecos grandiporosum*, new species | r. | | | | | | |

| Rich Hill, 5¼ miles southeast of Knoxville, Georgia. | 1½ miles northeast of Lilly, Dooly County, Georgia. | ½ mile southeast of Georgia Kaolin Co. Mine, Twiggs County, Georgia. | 17 miles northeast of Hawkinsville, Georgia. | 3¼ miles south of Perry, Georgia. | 12 miles southeast of Marshallville, Georgia. | 18 miles west of Wrightsville, Georgia. | 3½ miles north of Grovania, Georgia. | Bainbridge, Georgia. | 1½ miles above Bainbridge, Georgia. | 7 miles above Bainbridge, Georgia. | 4 miles below Bainbridge, Georgia. | West Bank of Sepulga River, Escambia County, Alabama. | Alachua, Florida. | Ocala, Florida. | Chipola River, east of Marianna, Florida. | Shubuta, Mississippi. | Cocoa post office, Choctaw County, Alabama. | Suck Creek, Clarke County, Mississippi. |
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| ...... | ...... | r. | r. | v.r. | ...... | r. | ...... | ...... | ...... | ...... | ...... | r. | ...... | ...... | ...... | ...... | ...... | ...... |
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| r. | ...... | r. | v.r. | r. | r. | ...... | ...... | ...... | r. | ...... | ...... | r. | ...... | ...... | ...... | ...... | ...... | ...... |
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| r. | ...... | ...... | ...... | ...... | ...... | r. | ...... | ...... | ...... | ...... | ...... | ...... | ...... | ...... | ...... | ...... | ...... | ...... |
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| ...... | ...... | r. | ...... | ...... | ...... | ...... | ...... | ...... | ...... | ...... | ...... | ...... | ...... | ...... | ...... | ...... | ...... | ...... |
| ...... | ...... | ...... | ...... | r. | ...... | ...... | ...... | ...... | ...... | ...... | ...... | ...... | ...... | ...... | ...... | ...... | ...... | ...... |
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| ...... | ...... | r. | ...... | ...... | ...... | ...... | r. | ...... | ...... | ...... | ...... | ...... | ...... | ...... | ...... | r. | ...... | ...... |
| ...... | ...... | ...... | ...... | ...... | ...... | ...... | ...... | v.r. | c. | ...... | ...... | ...... | ...... | ...... | ...... | ...... | ...... | ...... |
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| Other occurrences.[1] | JACKSONIAN CYCLOSTOMATOUS BRYOZOA. [v. r.=very rare; r.=rare; c=common; v. c.=very common.] | Jackson, Mississippi. | 2¼ miles north of Roberts, Mississippi. | 3½ miles southeast Shell Bluff post office, Georgia. | Wilmington, North Carolina. | Eutaw Springs, South Carolina. | Near Lenuds Ferry, South Carolina. | Baldock, Barnwell County, South Carolina. | Rich Hill, 5¼ miles southeast of Knoxville, Georgia. |
|---|---|---|---|---|---|---|---|---|---|
| V. | *Stomatopora parvipora*, new species | v. r. | | | r. | | | | |
| V. | *Stomatopora polygona*, new species | r. | | | v. c. | r. | v. r. | | |
| | *Stomatopora excavans*, new species | | | | v. r. | | | | |
| | *Stomatopora cornu*, new species | | | | | | | | |
| | *Stomatopora pratti*, new species | | | | c. | | r. | | |
| | *Stomatopora striatula*, new species | | | | r. | | r. | | |
| | *Stomatopora fasciolata*, new species | | | | | | | | |
| | *Proboscina rugosa*, new species | | | | | r. | | | |
| | *Proboscina projecta*, new species | | | | r. | | | | |
| | *Proboscina geminata*, new species | r. | | | r. | | | | |
| | *Proboscina anceps*, new species | | | | r. | | | | |
| | *Proboscina expatiata*, new species | | | | r. | | | | |
| | *Proboscina alternata*, new species | | | | v. r. | | | | |
| | *Proboscina divergans*, new species | | | | | | v. r. | | |
| | *Proboscina colubra*, new species | | | | v. r. | r. | r. | | |
| | *Proboscina clavatula*, new species | | | | r. | v. r. | v. r. | | |
| | *Proboscina striatula*, new species | | | | v. r. | r. | | | |
| | *Proboscina prominens*, new species | | | | c. | | | | |
| | *Proboscina undulata*, new species | | | | v. r. | | | | |
| | *Proboscina parviangulata*, new species | | | | c. | r. | c. | | |
| | *Proboscina exigua*, new species | | | | | | | | |
| V. | *Proboscina latobrevis*, new species | | | | | | | | |
| | *Proboscina idmonoides*, new species | | | | | | | | |
| | *Proboscina magniramosa*, new species | | | | | | | | |
| | *Berenicea ingens*, new species | | | v. r. | | | | | |
| V. | *Plagioecia divagans*, new species | | | | r. | r. | r. | | v. r. |
| | *Berenicea benjamini*, new species | | | | | r. | | | |
| | *Berenicea incondita*, new species | | | | | | | | r. |
| | *Diastopora tubiformis*, new species | | | | | | r. | | |
| | *Diastopora striatisemota*, new species | | | | | | | | |
| | *Spiropora majuscula*, new species | | | | | c. | v. c. | | |
| | *Ceriopora aldrichi*, new species | | | | c. | | | | |
| | *Ceriopora (?) proposita*, new species | | | | | | | | |
| | *Heteropora ovalis*, new species | r. | | | | | | | |
| | *Heteropora amaena* De Gregorio, 1890 | v. r. | | | | | | | |
| V. | *Filisparsa fallax*, new species | v. c. | | | | | | | |
| V. | *Filisparsa ingens*, new species | | | | v. c. | c. | c. | | |
| V. | *Crisia hornesi* Reuss, 1847 | c. | | | | | | | |
| | *Crisia edwardsi* Reuss, 1847 | | | | | | r. | | |
| | *Crisia cribraria* Stimpson, 1853 | r. | | | | | | | |
| | *Crisia lowei*, new species | v. r. | | | | | | | |
| | *Plagioecia concreta*, new species | | | | v. c. | | v. r. | | |
| | *Plagioecia globulosa*, new species | | | | r. | | | | |
| | *Plagioecia lamellosa*, new species | | | | r. | | | | |
| | *Plagioecia botula*, new species | | | | r. | | | | |
| V. | *Plagioecia hirta*, new species | c. | | | r. | | r. | | r. |
| | *Plagioecia marginata*, new species | | | | | r. | c. | | |
| | *Desmeplagioecia dichotoma*, new species | | | | | | | | |
| V. | *Desmeplagioecia compressa*, new species | | | | | | | | |
| | *Desmeplagioecia plicata*, new species | | | | r. | | r. | | |
| | *Desmeplagioecia lobata*, new species | | | | | r. | | | |
| | *Desmeplagioecia (Actinopora) brevis*, new species | | | | | | | | |
| | *Desmeplagioecia (Actinopora) tenuissima*, new species | | | | | | | | |
| M. V. | *Mecynoecia proboscidea* Milne-Edwards, 1838 | | | | v. c. | | v. c. | v. r. | v. c. |
| | *Mecynoecia cylindrica*, new species | | | | v. c. | | v. r. | | |
| | *Mecynoecia pusilla*, new species | | | | | | v. r. | | |
| | *Mecynoecia brevis*, new species | | | | | v. r. | | | r. |
| | *Mecynoecia magnicellae*, new species | | | | | | | | |
| V. | *Mecynoecia parvituba*, new species | | | | | | | | |
| | *Microecia flabellata*, new species | | | | r. | | | | |
| V. | *Microecia vibrio*, new species | | | | | | | | |
| | *Diaperoecia longicauda*, new species | | | | v. r. | | | | |
| | *Diaperoecia jacksoniensis*, new species | v. r. | | | | | | | |
| | *Diaperoecia lobulata*, new species | | | | r. | | | | c. |
| | *Diaperoecia lobulata* var. *parvipora*, new variety | | | | | v. r. | v. r. | | |
| | *Diplosolen planum*, new species | | | | | | r. | | |
| | *Tubulipora interrupta*, new species | | | | | | | | v. r. |
| C. V. | *Pleuronea fenestrata* Busk, 1859 | v. c. | | | | | | v. r. | |
| | *Platonea lamellifera*, new species | | | c. | | | | | |
| C. V. | *Pleuronea subpertusa*, new species | c. | | | | | | | v. r. |

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[1] M.-Midwayan; C.-Claibornian; V.-Vicksburgian.

| 1½ miles southeast Lilly, Dooly County, Georgia. | ½ mile southeast of Georgia Kaolin Company Mine, Twiggs County, Georgia. | 17 miles northeast of Hawkinsville, Georgia. | 3 miles south of Perry, Georgia. | 12 miles southeast of Marshallville, Georgia. | 18 miles north of Wrightsville, Georgia. | 3½ miles north of Grovania, Georgia. | Bainbridge, Georgia. | 1½ miles above Bainbridge, Georgia. | 7 miles above Bainbridge, Georgia. | 4 miles below Bainbridge, Georgia. | West Bank of Sepulga River, Escambia County, Alabama. | Alachua, Florida. | Ocala, Florida. | Chipola River east of Marianna, Florida. | Shubuta, Mississippi. | Cocoa post office, Choctaw County, Alabama. | Suck Creek, Clarke County, Mississippi. | Pachuta, Clarke County, Mississippi. |
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| ...... | ...... | r. | ...... | ...... | ...... | ...... | ...... | ...... | ...... | ...... | ...... | ...... | ...... | v. r. | ...... | ...... | ...... | ...... |
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| ...... | ...... | ...... | c. | ...... | ...... | ...... | ...... | ...... | ...... | ...... | ...... | ...... | ...... | ...... | ...... | ...... | ...... | ...... |
| ...... | r. | ...... | ...... | ...... | ...... | r. | ...... | ...... | ...... | ...... | ...... | ...... | ...... | ...... | ...... | ...... | ...... | ...... |
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| ...... | r. | ...... | ...... | r. | ...... | ...... | ...... | ...... | ...... | ...... | v. r. | ...... | ...... | ...... | ...... | ...... | ...... | ...... |
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| ...... | ...... | ...... | ...... | ...... | ...... | ...... | ...... | c. | r. | ...... | ...... | ...... | ...... | r. | ...... | ...... | r. | v. r. |
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| ...... | ...... | ...... | ...... | ...... | ...... | ...... | ...... | r. | ...... | ...... | ...... | ...... | ...... | ...... | ...... | ...... | ...... | ...... |
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| ...... | ...... | ...... | ...... | ...... | ...... | ...... | ...... | ...... | ...... | ...... | ...... | v. r. | v. r. | ...... | ...... | ...... | ...... | ...... |
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| ...... | r. | v. r. | v. c. | v. c. | r. | r. | ...... | v. r. | ...... | ...... | c. | ...... | ...... | c. | ...... | ...... | ...... | ...... |
| ...... | ...... | ...... | ...... | ...... | v. r. | r. | ...... | ...... | ...... | ...... | ...... | ...... | ...... | ...... | ...... | ...... | ...... | ...... |
| ...... | ...... | ...... | ...... | ...... | ...... | v. r. | ...... | ...... | ...... | ...... | ...... | ...... | ...... | r. | ...... | ...... | ...... | ...... |
| ...... | v. r. | ...... | ...... | ...... | v. r. | ...... | ...... | ...... | ...... | ...... | ...... | ...... | ...... | ...... | v. c. | ...... | v. r. | ...... |
| ...... | ...... | ...... | ...... | ...... | ...... | ...... | ...... | ...... | ...... | ...... | ...... | v. r. | ...... | ...... | ...... | ...... | ...... | ...... |
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| ...... | r. | ...... | ...... | r. | ...... | ...... | ...... | ...... | ...... | ...... | ...... | ...... | ...... | ...... | c. | ...... | ...... | ...... |
| ...... | ...... | ...... | ...... | ...... | ...... | ...... | ...... | ...... | ...... | ...... | ...... | ...... | ...... | ...... | ...... | ...... | ...... | ...... |
| ...... | ...... | ...... | ...... | ...... | ...... | ...... | ...... | v. r. | ...... | ...... | ...... | ...... | ...... | ...... | ...... | ...... | ...... | ...... |

| Other occurrences. | JACKSONIAN CYCLOSTOMATOUS BRYOZOA. [v.r.=very rare; r.=rare; c.=common; v.c.=very common.] | Jackson, Mississippi. | 2⅓ miles north of Roberts, Mississippi. | 3½ miles southeast of Shell Bluff post office, Georgia. | Wilmington, North Carolina. | Eutaw Springs, South Carolina. | Near Lenuds Ferry, South Carolina. | Baldock, Barnwell County, South Carolina. | Rich Hill, 5¼ miles southeast of Knoxville, Georgia. |
|---|---|---|---|---|---|---|---|---|---|
| | *Centronea micropora* Reuss, 1869 | | | | v. c. | | | | |
| | *Erkosonea semota*, new species | c. | | | | | | | |
| | *Erkosonea admota*, new species | | | | v. c. | r. | r. | | |
| | *Tretonea levis*, new species | | | r. | | | | | |
| | *Idmonea magna*, new species | c. | | | | v. r. | | r. | v. c. |
| V. | *Idmonea milneana* D'Orbigny, 1839 | | | | v. c. | | | | |
| | *Idmonea arcuata*, new species | | | | r. | | v. c. | | |
| | *Idmonea sloani*, new species | | | | v. r. | | c. | | |
| | *Idmonea magnireversa*, new species | | | | v. c. | | | | |
| V. | *Idmonea grallator*, new species | | | | v. c. | r. | c. | | |
| V. | *Idmonea atlantica* Johnston, 1847 | | | | v. c. | | | | |
| | *Idmonea parvula*, new species | | | | | | | | |
| | *Idmonea filiformis*, new species | | | | r. | | | | |
| V. | *Idmonea petri* D'Archiac, 1846 | | | | v. r. | r. | r. | | |
| | *Idmidronea rosacea*, new species | | | | r. | | | | |
| | *Idmidronea maxillaris* Lonsdale, 1845 | | | | v. c. | | v. c. | | |
| | *Idmidronea culter*, new species | | | | v. c, | r. | v. c. | | |
| | *Tervia gracilis*, new species | | | | v. c. | | v. c. | | |
| | *Tervia parvula*, new species | | | | | | | | |
| | *Tervia tumida* Smitt, 1871 | | | | r. | | | | |
| | *Hornera jacksonica*, new species | | | | v. c. | | | r. | |
| | *Hornera reteramae*, new species | | | | r. | | | | |
| | *Hornera polyporoides*, new species | c. | | | c. | | | | |
| | *Hornera tenuirama*, new species | | | | v. c. | | | | |
| | *Hornera tuberosa*, new species | | | | | | | | |
| V. | *Hornera porosa* Stoliczka, 1862 | | | | r. | | | v. r. | v. r. |
| | *Polyascosoecia jacksonica*, new species | | | | | r. | | c. | r. |
| | *Polyascosoecia imbricata*, new species | r. | | | | | | | |
| | *Frondipora laevigata*, new species | | | | r. | | | | |
| | *Frondipora interporosa*, new species | | | | | | r. | | |
| | *Telopora* (?) *patens*, new species | | | | r. | | | | |
| | *Fasciculipora surculifera*, new species | | | | | | | | |
| | *Lichenopora boletiformis* Reuss, 1869 | | | | c. | c. | | r. | |
| | *Lichenopora verrucosa* Philippi, 1843 | | | | r. | | r. | | |
| M. C. | *Lichenopora grignonensis* Milne-Edwards, 1838 | c. | | c. | v. c. | c. | v. c. | | r. |
| | *Lichenopora grignonensis*, var. *multilamellosa*, new variety | | | | | | | r. | c. |
| | *Parleiosoecia jacksonica*, new species | | | | r. | v. c. | r. | | r. |
| | *Tretocycloecia grandis*, new species | v. r. | | | | | | | |
| | *Tretocycloecia reticulata*, new species | | | | | v. c. | r. | | |
| | *Partretocycloecia reptans*, new species | | | | | | v. r. | | |
| | *Partretocycloecia porosa*, new species | | | | | c. | | | |

| 1½ miles southeast Lilly, Dooly County, Georgia. | ½ mile southeast of Georgia Kaolin Company Mine, Twiggs County, Georgia. | 17 miles northeast of Hawkinsville, Georgia. | 3 miles south of Perry, Georgia. | 12 miles southeast of Marshallville, Georgia. | 18 miles north of Wrightsville, Georgia. | 3½ miles north of Grovania, Georgia. | Bainbridge, Georgia. | 1½ miles above Bainbridge, Georgia. | 7 miles above Bainbridge, Georgia. | 4 miles below Bainbridge, Georgia. | West Bank of Sepulga River, Escambia County, Alabama. | Alachua, Florida. | Ocala, Florida. | Chipola River east of Marianna, Florida. | Shubuta, Mississippi. | Cocoa post office, Choctaw County, Alabama. | Suck Creek, Clarke County, Mississippi. | Pachuta, Clarke County, Mississippi. |
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| | | | | | r. | | v. r. | | | | r. | | | v. r. | | | | |
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| v. c. | c. | c. | c. | v. c. | c. | c. | | v. r. | | | v. c. | c. | | | | | | |
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## VICKSBURGIAN CHEILOSTOMATOUS BRYOZOA.

[v. r.=very rare; r.=rare; c.=common; v. c.=very common.]

| Other occurrences.[1] | | Red Bluff, Wayne County, Mississippi | 7½ miles southwest of Bladon Springs, Alabama. | 1 mile north of Monroeville, Alabama. | Murder Creek, east of Castlebury, Alabama. | West Bank Conecuh River, Escambia County, Alabama. | Salt Mountain, 5 miles south of Jackson, Alabama. | 2½ miles north of Millry, Alabama. | Near Claiborne, Alabama. | 3 miles southeast of Vosburg, Jasper County, Mississippi. | Deep well, Escambia County, Alabama. | Vicksburg, Mississippi. | Byram, Mississippi. | ¼ mile north of Woodward, Mississippi. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | *Herpetopora danica* Lang, 1914 | | | v. r. | | | | | | | | | | |
| | *Conopeum concavum*, new species | | | | | | | | | | | r. | | |
| | *Membraniporina tubulosa*, new species | | | v. c. | | | | v. r. | | | | | | |
| | *Membraniporina arcana*, new species | | | r. | | | | | | | | | | |
| | *Acanthodesia savartii* Audouin, 1826 | | | v. c. | | | | | | v. r. | | | | |
| C. J | *Trochopora bouei* Lea, 1833 | r. | | | | | | | | | | | | |
| | *Hincksina elegans*, new species | | | v. r. | | | | | | | | | | |
| J. | *Hincksina ocalensis* (?), new species | | | | | | | | | | | | r. | |
| J. | *Hincksina costulifera* (?), new species | | | v. c. | | | | | | | | | | |
| | *Membrendoecium loweri*, new species | | | | | | | | | | | r. | | |
| | *Membrendoecium pyriforme*, new species | | v. r. | | v. r. | | c. | | v. r. | | v. r. | | | |
| C. J. | *Membrendoecium rectum*, new species | | | c. | | v. r. | | | r. | | | | | |
| J. | *Grammella pusilla*, new species | | | r. | | | | | | | | | | |
| J. | *Membraniporidra spissimuralis*, new species | | | v. c. | v. c. | v. c. | v. c. | | v. c. | | | | | |
| | *Membraniporidra similis*, new species | | | r. | | | | | | | | v. r. | | |
| | *Callopora vicina*, new species | | | c. | | | | | | | | | | |
| | *Amphiblestrum curvatum*, new species | | | r. | | | | | | | | | | |
| | *Stamenocella intermedia*, new species | | | | | v. r. | | | | | | | | |
| J. | *Stamenocella mediaviculifera* (?), new species | | | | | | r. | | r. | | | | | |
| J. | *Stamenocella inferaviculifera*, new species | | | c. | r. | r. | r. | | | | | | | r. |
| J. | *Stamenocella grandis*, new species | | | r. | | | | | | | | | | r. |
| | *Scrupocellaria cookei*, new species | | v. r. | | | | c. | | | | | | | r. |
| | *Scrupocellaria milneri*, new species | | r. | | v. r. | c. | r. | | | | | | | |
| | *Scrupocellaria resseri*, new species | | | | | c. | | | | | | | | |
| | *Scrupocellaria williardi*, new species | | | | | | r. | | | | | | | r. |
| | *Scrupocellaria triangulata*, new species | | | | | r. | | | | | | | | |
| | *Scrupocellaria rathbuni*, new species | | | | | r. | | | | | | | | |
| | *Scrupocellaria vaughani*, new species | | v. r. | | | | | | | | | | | |
| | *Scrupocellaria clausa*, new species | | | | r. | r. | r. | | | | | | | v. r. |
| | *Caberea boryi* Audouin, 1826 | | | | | v. r. | | | | | | | | |
| | *Nellia oculata* Busk, 1852 | | | | | | v. c. | | | | | r. | r. | r. |
| J. | *Nellia bifaciata*, new species | | | | | r. | | | | | | | r. | |
| | *Heterocella vicksburgica*, new species | | | | | | c. | | | | | | | |
| J. | *Rectonychocella tenuis*, new species | | r. | | | | | | | | | | | |
| | *Diplopholeos lineatum*, new species | | | | | | v. r. | | v. r. | | | | r. | |
| J. | *Floridina antiqua* Smitt, 1873 | | | | | | c. | | | | | | r. | |
| | *Rosseliana parvipora*, new species | | | r. | | | | | | | | | | |
| | *Floridinella vicksburgica* Canu and Bassler, 1917 | | | v. c. | v. c. | v. c. | | v. c. | v. c. | | | | | |
| C. J. | *Micropora coriacea* Esper, 1791 | | | | | r. | r. | | r. | | v. r. | | | |
| | *Lunularia* (*Oligotresium*) *vicksburgensis* Conrad, 1847 | r. | | | | | | | | | | r. | c. | c. |
| J. | *Lunularia distans* Lonsdale, 1845 | | | r. | | r. | | | | | | | | |
| | *Lunularia tintinabula*, new species | r. | | | | | | | | | | r. | | v. r. |

[1] C=Claibornian; J=Jacksonian.

| Other occurrences. | VICKSBURGIAN CHEILOSTOMATOUS BRYOZOA. [v. r.=very rare; r.=rare; c.=common; v. c.=very common.] | Red Bluff, Wayne County, Mississippi. | 7½ miles southwest of Bladon Springs, Alabama. | 1 mile north of Monroeville, Alabama. | Murder Creek, east of Castlebury, Alabama. | West Bank Conecuh River, Escambia County, Alabama. | Salt Mountain, 5 miles south of Jackson, Alabama. | 2⅓ miles north of Millry, Alabama. | Near Claiborne, Alabama. | 3 miles southeast of Vosburg, Jasper County, Mississippi. | Deep well, Escambia County, Alabama. | Vicksburg, Mississippi. | Byram, Mississippi. | ¼ mile north of Woodward, Mississippi. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | *Lunularia verrucosa*, new species | | | r. | | | | | | | | | | |
| | *Lunularia ligulata*, new species | r. | | | | | | | | | | | | |
| | *Rhagasostoma levigatum*, new species | | | | | | v. r. | | | | | | | |
| | *Steganoporella vicksburgica*, new species | | | | c. | c. | c. | | c. | | | | | |
| | *Thalamoporella prima*, new species | | | | | | | | | | | | | |
| | *Membraniporella (?) subagassizi*, new species | | | c. | | | | | | | | | | |
| J. | *Puellina sinulator*, new species | | | r. | | v. r. | | | r. | | | | | |
| J. | *Puellina radiata*, Moll, 1803 | | | c. | | | r. | | | c. | | | | |
| J. | *Puellina radiata anaticula*, new variety | | | | | | | | | | | | r. | |
| J. | *Puellina radiata carolinensis* Gabb and Horn, 1862 | | r. | r. | | | | | | | | | | |
| | *Puellina inarmata*, new species | | | | r. | r. | | | | | | | | |
| | *Gephyrotes spectabilis*, new species | | | | | | | | | | | | v. r. | |
| | *Arachnopusia vicksburgica*, new species | | | | | | | | | | | | r. | r. |
| | *Acropora saillans*, new species | | v. r. | v. c. | | | | | | | | | | |
| | *Trypostega inornata* Gabb and Horn, 1862 | | | c. | r. | r. | r. | | r. | r. | v. r. | | | |
| | *Trypostega venusta* Norman, 1869 | | | | | | | | r. | | | | v. r. | r. |
| | *Stephanosella entomostoma* Reuss, 1864 | | | v. c. | | c. | | | r. | | | | | |
| | *Stephanosella parvipora*, new species | | | | | | | | | r. | | | | |
| | *Lacerna hexagonalis*, new species | | | r. | v. r. | r. | r. | | r. | | | | | |
| | *Schizomavella arborea*, new species | | | v. c. | | | | | | | | | | |
| | *Schizomavella longirostris*, new species | r. | | | | | | | | | | | | |
| J. | *Hippoporina luccas*, new species | | | r. | | | | | | | | | r. | |
| | *Hippoporella perforata*, new species | | | | | c. | | | | | | | | |
| | *Hippomenella capitimortis*, new species | | | | | c. | c. | | c. | | v. r. | | | |
| | *Hippomenella costulata*, new species | | c. | v. c. | | | | | | | | | | |
| | *Hippomenella transversora*, new species | | | v. r. | v. r. | r. | | | | | | | | |
| | *Hippomenella pungens*, new species | | | v. c. | | | | | | | | | | |
| J. | *Hippomenella crassicollis*, new species | | | | | | | | r. | | | | | v. r. |
| | *Hippodiplosia magniporosa*, new species | | v. r. | | | | r. | | | | | | | |
| | *Hippodiplosia baccata*, new species | r. | | | | | | | | | | | c. | |
| | *Hippodiplosia strangulata*, new species | | | | r. | r. | | | r. | | | r. | v. r. | |
| | *Peristomella coccinea* Abilgaard, 1805 | | | | r. | c. | | | | | | | | |
| | *Peristomella coccinea resupinata* Manzoni, 1875 | | | r. | | | | | | | | | | |
| | *Peristomella erecta*, new species | | | | | | | | r. | | | | | |
| | *Didymosella crassa* Canu and Bassler, 1917 | | | r. | c. | c. | | | r. | | v. r. | | | |
| | *Cyclicopora colum*, new species | | | v. r. | | | | | | | | | | |
| | *Cyclicopora spongiopsis* De Gregorio, 1890 | | c. | v. c. | | | | | c. | | | | | |
| | *Cyclicopora filifera*, new species | | | | | | | | r. | | v. r. | | | |
| | *Stomachetosella crassicollis* Canu and Bassler, 1917 | | | | | v. c. | | | r. | | | | | |
| | *Enoplostomella synthetica*, new species | | | | | | | | | | | | c. | v. r. |
| | *Enoplostomella crassimuralis*, new species | | | | | | v. r. | | r. | | v. r. | | | |
| | *Enoplostomella rhomboidalis*, new species | | | r. | | | | r. | | | | | | |
| | *Enoplostomella defixa*, new species | | | v. c. | | | | | | | | | | |
| | *Enoplostomella ligulifera*, new species | | v. c. | | | | | | | | | | | |
| | *Enoplostomella vallata*, new species | | | | v. c. | v. c. | | | | | | | | |

| Other occurrences. | VICKSBURGIAN CHEILOSTOMATOUS BRYOZOA. [v. r.=very rare; r.=rare; c.=common; v. c.=very common.] | Red Bluff, Wayne County, Mississippi. | 7½ miles southwest of Bladon Springs, Alabama. | 1 mile north of Monroeville, Alabama. | Murder Creek, east of Castleburv, Alabama. | West Bank Conecuh River, Escambia County, Alabama. | Salt Mountain, 5 miles south of Jackson, Alabama. | 2½ miles north of Millry, Alabama. | Near Claiborne, Alabama. | 3 miles southeast of Vosburg, Jasper County, Mississippi. | Deep well, Escambia County, Alabama. | Vicksburg, Mississippi. | Byram, Mississippi. | ¼ mile north of Woodward, Mississippi. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | *Enoplostomella magniporosa*, new species | | | | | | | | | | | | c. | |
| | *Leiosella rostrifera*, Canu and Bassler, 1917 | | c. | v. c. | | | | | | | | | | |
| | *Leiosella grandisora*, new species | | | v. r. | | | | | | | | | | |
| | *Leiosella orbicularia*, new species | r. | | | | | | | | | | | | |
| J. | *Smittina angulata* Reuss, 1865 | v. r. | | | | | | | | | | | | |
| | *Smittina cophia*, new species | | | | | r. | | | | | | | | |
| | *Smittina ampla*, new species | | | | r. | c. | c. | | c. | | | | | |
| | *Smittina reticuloides*, new species | | | v. c. | | | | | | | | | | |
| | *Smittina telum*, new species | | | v. c. | | | | | | | | | | |
| | *Smittina granulosa*, new species | | | | | v. r. | | | | | v. r. | | | |
| | *Smittina* (?) *pupa*, new species | | | c. | | | | | | | | | | |
| | *Smittina tubulata* Gabb and Horn, 1862 | | r. | v. c. | | | | | | | | | | |
| | *Porella crassoparies*, new species | | | | c. | c. | | | c. | | | | | |
| | *Porella cylindrica*, new species | | | c. | | | | | | | | | | |
| | *Porella erecta*, new species | | r. | | | | | | | | | | | |
| | *Porella compacta*, new species | | | | | | | | | | | | v. r. | c. |
| | *Umbonula* (?) *miser*, new species | | | | | | r. | | | | | | | |
| | *Umbonula ceratomorpha* Reuss, 1847 | | v. r. | | r. | r. | r. | | | | | | | |
| | *Retepora laciniosa*, new species | | | c. | r. | c. | r. | r. | | | | | | c. |
| J. | *Semihasweltia exilis*, new species | | | | | v. c. | | r. | | | | | | |
| | *Tubucellaria vicksburgica*, new species | | r. | c. | | c. | c. | r. | r. | | v. r. | v. r. | r. | r. |
| | *Metrarabdotos moniliferum* Edwards and Haime, 1836 | | | v. c. | | | | r. | c. | | | c. | | |
| | *Metrarabdotos grande*, new species | r. | v. r. | | | | | | | v. r. | | | | |
| | *Catenicella subseptentrionalis* Canu and Bassler, 1917 | | | | | | v. r. | | | | | | | |
| | *Meniscopora elliptica*, new species | | | | | | | | | | | | | c. |
| | *Adeonellopsis grandis*, new species | | | v.a.b. | | | | | | | | | | |
| | *Adeonellopsis galeata*, new species | r. | | | | | | r. | | | v. r. | | c. | |
| | *Adeonellopsis cyclops*, new species | | v. r. | | c. | c. | | | c. | | | | v. r. | |
| | *Phylactella cribrata*, new species | | | r. | | | | | | | | | | |
| J. | *Perigastrella ovoidea* Canu and Bassler, 1917 | | | | | | | | | | r. | | | |
| | *Perigastrella plana*, new species | | | v. c. | c. | c. | c. | | v. c. | | | | r. | |
| | *Perigastrella ? costifera*, new species | | | | v. r. | c. | | | | | | | | |
| J. | *Mastigophora hyndmanni* Johnston, 1847 | | | r. | | v. r. | | | | | | | | |
| J. | *Mastigophora dutertrei* Savigny-Audouin, 1826 | | | r. | | | | | | | | | | |
| J. | *Lagenipora americana*, new species | | | v. r. | | | | | | | | | | |
| J. | *Osthimosia glomerata* Gabb and Horn, 1862 | | | | | | | | | | | c. | | |
| | *Costazzia antiqua*, new species | | | | | v. r. | | | | | | | | |
| | *Holoporella seposita*, new species | | | | r. | c. | c. | | r. | | | | | |
| J. | *Holoporella fissurata*, new species | | | | r. | r. | | | | | | | | |
| | *Holoporella peristomaria*, new species | | | | | | | | | | | | v. r. | |
| | *Holoporella discus*, new species | | | v. c. | | | | | | | | | | |
| | *Kleidionella verrucosa*, new species | | | v. c. | | | | | | | | | | |
| J. | *Kleidionella grandis* Canu and Bassler, 1917 | r. | r. | | | | | | | | | | | |
| | *Fedora pusilla*, new species | | | | | | | | | | | | | r. |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | *Stomatopora miauta*, new species | | | | v. r. | | | | | | | | | |
| J. | *Stomatopora parvipora*, new species | | | v. r. | | | | | | | | | | |
| J. | *Stomatopora polygona*, new species | | | v. r. | | | r. | | | | | | | |
| | *Proboscina subechinata*, new species | | | | | | r. | | r. | | | | | |
| | *Proboscina rectalinea*, new species | | | | | | r. | | | | | | | |
| | *Proboscina conveniens*, new species | | | | | | r. | | | | | | | |
| | *Proboscina clavatiramosa*, new species | | | | | | r. | | r. | | | | | |
| J. | *Proboscina latobrevis*, new species | | | | | | | | r. | | | | | |
| | *Proboscina cranei*, new species | | | | | | v. r. | | | | | | | |
| J. | *Plagioecia divagaas*, new species | | | | | | | | | r. | | | | |
| | *Diastopora magnipora*, new species | | | | | | v. r. | | | | | | | |
| | *Oncousoecia varians* Reuss, 1869 | | | | v. r. | v. r. | c. | | c. | | | | | |
| | *Oacousoecia quinquseriata*, new species | | | r. | | r. | | | | | | | r. | c. |
| J. | *Filisparsa fallax*, new species | | | v. c. | | | | | | | | | | |
| | *Filisparsa atomicula*, new species | | | v. r. | | | | | | | | | | |
| | *Filisparsa bini*, new species | | r. | r. | | | | | | | | | | |
| | *Filisparsa gracilis*, new species | | c. | | | | | | | | | | | |
| | *Filisparsa typica* Manzoni, 1877 | | v. r. | | c. | v. c. | r. | | r. | | v. r. | | | |
| J. | *Filisparsa iagens*, new species | | | | | | v. r. | | | | | | | |
| | *Filisparsa simulator*, new species | | | v. c. | | | | | | | | | | |
| | *Filisparsa laxata*, new species | | r. | | r. | r. | | | | | | | | |
| | *Filisparsa biseriata*, new species | | | | | v. r. | | | | | | | | |
| J. | *Crisia hornesi* Reuss, 1847 | | r. | | | | | | | | | | | |
| | *Plagioecia discoidea*, new species | | | c. | | | | | | | | | | |
| J. | *Plagioecia hirta*, new species | | | | | | r. | | | | | | | |
| | *Desmeplagioecia* (*Actinopora*) *tenuis* Reuss, 1869 | | | c. | | | | | | | | | | |
| J. | *Desmeplagioecia compressa*, new species | | | | | | | | | | r. | | | |
| M. C. J. | *Mecynoecia proboscidea* Milne-Edwards, 1838 | | | v. c. | v. c. | v. r. | c. | | | | | | | |
| | *Mecynoecia compressa*, new species | | | r. | | | | | | | | | | |
| | *Mecynoecia quisenberryae*, new species | | | | | | c. | | | | | | | |
| | *Mecynoecia lunata*, new species | | | | v. c. | v. c. | | | c. | | | | | |
| | *Mecynoecia semota*, new species | | | v. c. | r. | v. c. | r. | | | | r. | | r. | |
| | *Mecynoecia elongatotubae*, new species | | c. | | v. r. | | | | | | | | | |
| | *Mecynoecia corauta*, new species | | | c. | | | | | | | v. r. | | | |
| | *Mecynoecia lobata*, new species | | | r. | | | | | | | | | | |
| J. | *Mecynoecia parvitubae*, new species | | | c. | | | | | | | | | | |
| | *Mecynoecia globula*, new species | | | r. | | | | | | | | | | |
| | *Microecia hirta*, new species | | | | | r. | | | | | | | | |
| J. | *Microecia vibrio*, new species | | | | | | r. | | | | | | | |
| | *Exochoecia rugosa*, new species | | r. | v. c. | r. | c. | v. r. | | c. | | | | r. | |
| | *Diaperoecia rugosa*, new species | | | | | | | | | r. | | | | |
| | *Diaperoecia orbiculata*, new species | | | v. c. | | | | | | | | | | |
| | *Diaperoecia clava*, new species | | | | r. | r. | v. c. | | r. | | | | r. | |
| | *Diaperoecia walcotti*, new species | | | | | r. | | | | | | | | |

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[1] M.=Midwayan; C.=Claibornian; J=Jacksonian.

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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
|  | *Crisulipora prominens*, new species |  |  | v. r. |  | r. |  |  |  |  |  |  |  |  |
|  | *Crisulipora rugosodorsalis*, new species |  |  | r. |  | r. |  |  |  |  |  |  |  |  |
|  | *Crisulipora flabellata*, new species |  |  | r. |  |  |  |  |  |  |  |  |  |  |
|  | *Crisulipora grandipora*, new species |  |  |  | r. | c. |  |  |  |  |  |  |  |  |
|  | *Platonea clavata*, new species |  |  |  |  |  | r. |  |  |  |  |  |  |  |
| C. J. | *Pleuronea subpertusa*, new species |  |  |  |  |  |  |  |  |  |  | r. | r. |  |
|  | *Pleuronea fusiformis*, new species |  |  |  |  |  | v. r. |  |  |  |  |  |  |  |
| C. J. | *Pleuronea fenestrata* Busk, 1859 |  |  |  | v. r. |  | r. |  |  |  |  | r. |  |  |
| J. | *Idmonea grallator*, new species |  | r. | v. c. |  |  |  |  | v. r. |  |  |  |  |  |
| J. | *Idmonea milneana* D'Orbigny, 1839 |  |  |  |  |  |  |  |  |  |  |  | v. r. |  |
| J. | *Idmonea atlantica* Johnston, 1847 |  |  | r. |  |  |  |  |  |  |  |  |  |  |
| J. | *Idmonea petri* D'Archiac, 1846 |  |  |  |  | v. c. |  |  |  |  |  |  | r. |  |
|  | *Idmonea triforata* Canu, 1911 |  |  |  | v. c. | v. c. | c. |  | c. |  | r. |  | c. |  |
|  | *Idmonea grandiora*, new species |  |  | r. |  |  |  |  |  |  |  |  |  |  |
| J. | *Hornera porosa* Stoliczka, 1862 |  |  | v. c. |  |  |  |  |  |  |  |  |  |  |
|  | *Lichenopora prolifera* Reuss, 1847 |  |  |  |  |  | r. |  |  |  |  |  |  |  |
|  | *Lichenopora goldfussi* Reuss, 1864 |  |  | v. c. |  |  | c. |  | r. |  |  |  |  |  |
|  | *Partretocycloecia exilis*, new species |  |  | v. c. |  |  |  |  |  |  |  |  |  |  |

## GENERAL DESCRIPTION OF THE BRYOZOA.

The paper-like fronds called "sea mats" and the moss-like structures tossed up on our sea coasts to-day are not plants as they were long supposed to be, but are animal colonies consisting of a great number of small cells opening side by side. Before their true nature was learned, these organisms were termed *zoophytes* or *corallines*, but when it was discovered that each individual cell of the composite colony contained an animal with a complete alimentary canal, the name *Bryozoa*, or moss-like animal, was coined for them. Another term, *Polyzoa*, was introduced for the same group and is preferred by many English naturalists, but all of the continental and American authors employ the designation *Bryozoa*.

In spite of the great abundance of bryozoa in the recent seas and their very frequent occurrence as fossils, knowledge of their structure is unfortunately usually limited to the special student. For this reason the following remarks, devoid of scientific terms, so far as possible, have been introduced.

The bryozoa are small, composite, usually marine, animals arising from a free-swimming larva which becomes attached to some foreign object and then develops into the primary individual or ancestrula. By repeated budding from the ancestrula, colonies of various shapes and sometimes considerable size arise. Each individual animal or zooid is composed of a double-walled membranaceous or calcareous sac, the *zooecium*, within which is the visceral mass, the polypide, consisting of a freely suspended alimentary canal U shaped so that the mouth and anus open close to each other. The mouth is surrounded by the lophophore bearing a crown of hollow, slender, ciliated tentacles arranged in a circle or crescent. Both sexes are usually combined in the same zooid. It is a curious fact that the same zooecium may be inhabited at different times by different polypides.

The colony which the individual zooids form is known technically as the *zoarium;* it presents a great variety of form and structure, although the form is quite constant in individual species. Very frequently the zoaria grow over shells, stones, or other bodies, forming delicate incrustations of exquisite patterns. By the superposition of many such incrustations, hemispherical, globular, nodular, or irregular masses often of considerable size may result. Again the zoaria may arise in fronds or branching stems, and at other times they form open-meshed lacework of the most regular and beautiful patterns. Most bryozoa are attached either basally or by the greater part of their surface to extraneous objects, or are moored to the bottom by root-like appendages. In many forms the zoarium is regularly jointed to give greater mobility.

The individual zooids of the zoarium conform to a simple and definite type of structure throughout the class. The soft parts of the animal consist of an alimentary canal with three distinct regions discernible, esophagus, stomach, and intestine. The alimentary canal is inclosed in a sac and bent upon itself so that the two extremities are close to each other. The mouth or oral opening is either entirely or partially surrounded by a row of slender, hollow, ciliated tentacles which serve for respiration and for sweeping food toward the mouth. The two large divisions under which the Bryozoa are classed (Entoprocta and Ectoprocta) are based upon the position of the anal opening. In most cases the anal opening is situated without the row of tentacles (Ectoprocta); rarely it is placed within this row (Entoprocta). A heart and vascular system are wanting, but there are numerous leucocytes floating in the general cavity. A nervous ganglion is present between the mouth and anus and sends delicate nerve filaments to the tentacles and esophagus. The upper part of the sac is generally flexible and can be invaginated through the action of numerous longitudinal and transverse muscles which traverse the fluid-filled visceral cavity.

The reproductive organs are developed in various parts of the body cavity, although the spermatozoa occur usually in the lower and the ova in the upper part. The ova may be developed in a special receptacle, in an inflation of the surface or in a modified zooecium. The general term ooecium or ovicell is applied to all of these structures.

Many bryozoans exhibit, attached to the zooecium, organs resembling a bird's head, termed avicularia, and other bristle-like appendages named vibracula. The jaws of the avicularia open and close with a snapping motion which has given rise to the probably erroneous idea that they are organs of defense. The structure of these two organs is described in more detail in the consideration of the cheilostomatous bryozoa. Both the avicularia and vibracula are incapable of preservation in the fossil state, but their former presence is indicated by the pore-like excavations in which they lodged.

The extended polypide is withdrawn into the zooecium by the contraction of retractor muscles attached to the tentacular crown. In the bryozoa with flexible zooecia the contraction of the body walls by parietal muscles produces protrusion of the polypide, but in the rigid calcareous zoaria the means for protrusion are more complicated (see p. 59).

## CLASSIFICATION.

The Bryozoa and the Brachiopoda are considered as constituting the phyllum Molluscoidea, although some authors believe there is no relationship between them and regard the Bryozoa as representing a distinct phyllum. The two large subdivisions of the Bryozoa, Ectoprocta, and Entoprocta, based upon the position of the anus with reference to the tentacles have been mentioned before. These subclasses differ widely from each other in many respects and here again some authors believe they are not even distantly related. However, the great majority of these animals belong to the Ectoprocta and under this to the superorder Gymnolaemata. Five orders of Gymnolaemata are known, of which the Cheilostomata is perhaps the largest in number of species. The relations of these various classificatory terms are expressed in the following table:

# Phyllum MOLLUSCOIDEA.

## Class BRYOZOA.

### Subclass Entoprocta.

The row of tentacles encloses both the oral and anal orifices.

### Subclass Ectoprocta.

The tentacles surround the mouth only.

### Superorder PHYLACTOLAEMATA.

Fresh-water Ectoprocta with the tentacles arranged in horse-shoe shape and the mouth protected by an overhanging lip.

### Superorder GYMNOLAEMATA.

Almost exclusively marine Ectoprocta with a circular row of tentacles surrounding the mouth which is at their center.

### Order 1. TREPOSTOMATA.

Zooecia calcareous and superposed upon each other so as to form long tubes intersected by straight or curved partitions. Monticules or maculae of larger or smaller cells distributed on the surface at regular intervals. Range: Paleozoic only.

### Order 2. CRYPTOSTOMATA.

Gymnolaemata differing from the Trepostomata in that the primitive part of the tube is usually much shorter and the passage to the mature region is more abrupt. Triparietal gemmation. Probably the Paleozoic representatives of the Cheilostomata.

### Order 3. CTENOSTOMATA.

Zooecia gelatinous or chitinous with tooth-like processes resembling a comb closing the aperture when the tentacles are retracted. Range: Paleozoic to Recent.

### Order 4. CYCLOSTOMATA.

Zooecia calcareous and tubular with a circular aperture. Range: Paleozoic to Recent.

### Order 5. CHEILOSTOMATA.

Zooecia calcareous or chitinous with the aperture closed when the polypide is retracted, by a chitinous lip or operculum. Range: Mesozoic to Recent.

### STRUCTURE OF THE CHEILOSTOMATA.

*Bugula avicularia* is here selected for description to illustrate the structure of the Cheilostomata, because it is one of the most common recent bryozoa found on the seashore in all parts of the world and is an example of the class frequently studied. It grows in brown or purple chitinous, bushy tufts several inches high, attached to rocks or other objects. Upon examination (fig. 1) the fluffy mass is seen to be made up of narrow branching stems with root-like filaments at the base. Under a lens each stem is noted to be made up of box-shaped, chitinous structures—the zooecia, arranged in four longitudinal rows. The zooecia have a wide crescentic aperture near the distal end (*mo.*) on either side of which is a short, blunt spine. In front of some zooecia is a round structure—the ooecium (*ooec*), and on most of them is the bird's-head appendage—the avicularium (*avic*), supported on a short stalk. Beneath the wall of the zooecia, which is simply the hardened and thickened cuticle of the animal proper, is the soft body wall. This body wall is generally known as the *endocyst*, and some authors apply the term *ectocyst* to the hardened cuticle or zoarial skeleton. In this work, however, the term ectocyst designates the outer membrane covering the zoarial skeleton.

The anterior part of the polypide can be turned inside out like the fingers of a glove, within the posterior part. When this portion, the *introvert*, is extruded a circle of usually fourteen long slender tentacles (*tent.*) on a circular ridge or lophophore surrounding the mouth is seen at its anterior end. A pair of retractor muscles serves to retract the tentacles. Numerous cilia on the tentacles drive currents of water with their contained food particles toward the mouth (*mo*). The tentacles are probably tactile and also may serve in respiration. The *tentacle sheath* is the enclosing wall of the introvert.

The coelome or body cavity occupies a considerable part of the zooecial interior. A large double strand of spindle-shaped cells known as the funiculus (*funic*) connects the aboral end of the alimentary canal with the aboral wall of the zooecium. The body cavity contains a number of colorless corpuscles or leucocytes.

*Alimentary canal.*—The mouth (*mo*) at the base of the tentacles opens into the *pharynx* (*ph*) which by a shorter constricted tube leads to the stomach. The coecum is a long conical projection of the stomach directed toward the aboral end of the zooecium, to which it is attached by the funiculus. The intestine is directed upward and nearly parallels the esophagus; it opens outside the lophophore not far from the mouth in the anal aperture (*an*).

*Nervous and excretory systems.*—A small round ganglion located between the mouth and the anal aperture, giving off nerves to the various parts of the zooid, constitutes the nervous system. No special sense organs are developed.

Recognizable excretory organs are absent. It is probable that the leucocytes carry on the collection of the nitrogenous waste matter.

*Reproductive organs.*—Both sexes are united in the same zooid as in most bryozoa. The ovary (*ov.*) occurs about the middle part of the body cavity and the testis in the lower portion. The latter gives rise to a spherical mass of cells, the spermatidia (*sp.*) which develop into sperms with long mobile tails. After the sperms become free from each other they move about in the body cavity where fertilization takes place. Only one mature ovum at a time is developed from the ovary. After fertilization the ovum passes into the ovicell or ooecium (*ooec*) where development takes place.

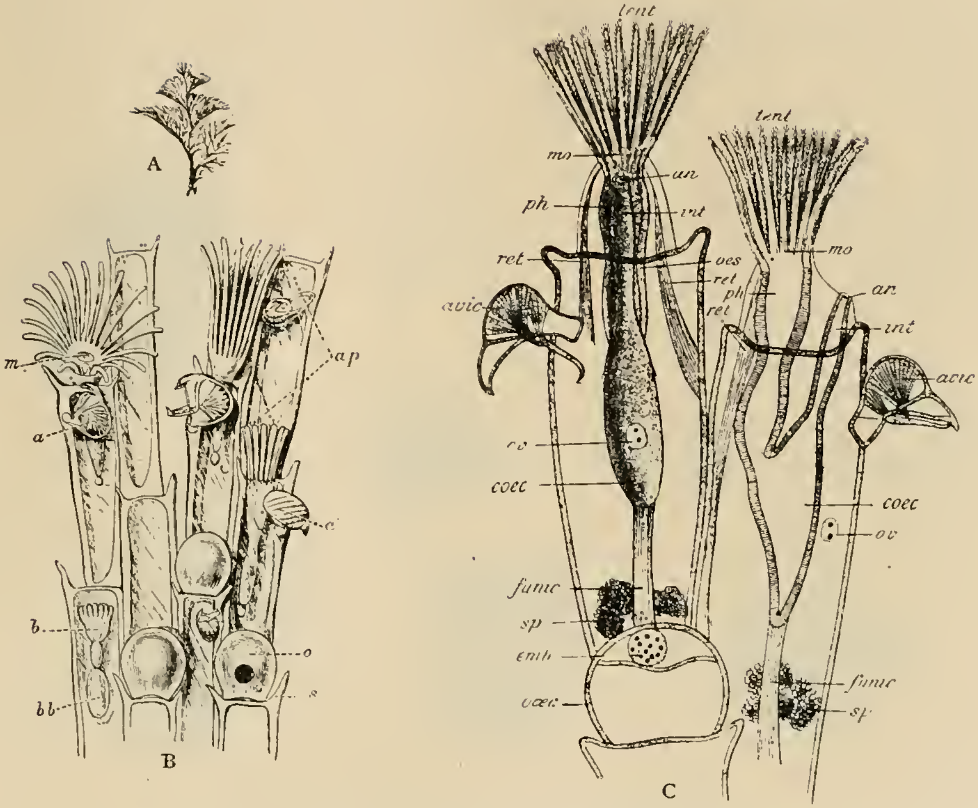

FIG. 1.—General Anatomy of the Cheilostomata.

A. B. Structure of a corneous cheilostomatous bryozoan, *Bugula turbinata* Alden, from the Atlantic at Plymouth, England.

A. A small copy or zoarium, natural size.

B. Portion of a branch, × 50, showing the zooid or polypide in various positions in the zooecium. *a, a'*, avicularia in different positions; *ap*, aperture of the zooecium covered by a membrane; *b*, polypide bud attached to *bb*, the brown body—the degenerated remains of an old polypide; *m*, mouth surrounded by the circle of tentacles; two individuals show the tentacles partly expanded; *o*, ovicell; *s*, marginal spines. In this figure the avicularia of some of the zooecia have been omitted. (A. B. After Harmer, 1896.)

C. Two zooids of the common bryozoan called the "Bird's Head Coralline" (*Bugula avicularia* Linnaeus), highly magnified. (After Parker and Haswell, 1910, with corrections.)

*an*, anus; *avic*, avicularia; *emb*, embryo enclosed in the ovicell (ooecium); *coec*, coecum; *funic*, funiculus; *int*, intestine; *mo*, mouth; *oes*, esophagus; *oocc*, ooecium (ovicell); *ov*, ovary; *ph*, pharynx; *ret*, large retractor muscles of polypide; *sp*, spermatidia; *tent*, tentacles.

The ganglion which is not indicated, lies just below the middle of the stroke from *mo*.

*Development of larva.*—Segmentation of the fertilized ovum is complete and nearly regular (see fig. 2). A blastula in the shape of a biconvex lens is formed and in its interior or blastocoele the primitive endoderm cells (*end*) become visible. These increase by division forming free cells which almost fill the blastocoele and represent probably both the endoderm and mesoderm. Small cavities occur in this mass of cells and form the primitive coelome by their union. Next the equatorial region of the embryo becomes thickened and provided with cilia forming the *corona* (fig. 2, G. *cor.*). On the oral side of the corona the circular pallial groove arises. The sucker, a structure which afterwards serves to fix the larva, then develops as a sac-like invagination of the ectoderm or what later becomes the oral side of the ciliated ridge. On the oral side near the corona a second depression

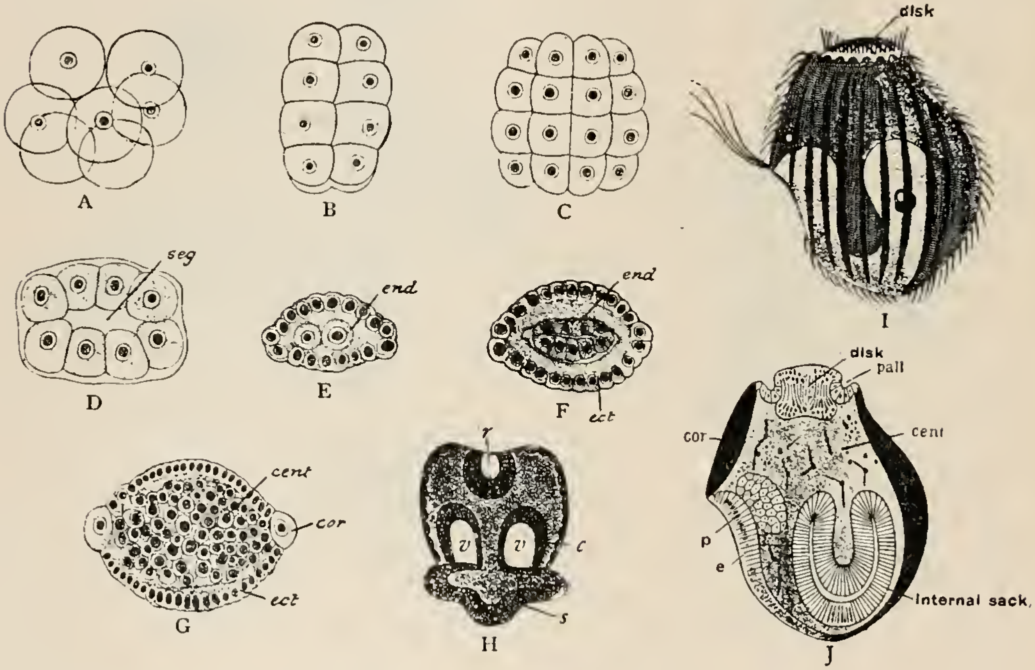

FIG. 2.—Early Stages in the Development of the Cheilostomata.

See text for description of the figures.

*A–G.* Drawings illustrating the development of *Bugula*. (After Vigelius.)

*cent*, central mass of cells; *cor*, corona; *ect*, ectoderm; *end*, endoderm; *seg*, segmentation cavity.

*H.* Longitudinal section of the attached larva of *Bugula*.

*c*, cells of corona; *r*, rudiment of the zooid in the form of a sac; *s*, basal plate of everted sucker; *v*, vestibule.

*I.* Larva of *Bugula plumosa*, highly magnified.

*J.* Sagittal section of *Bugula* (H-J after Barrois).

*cent*, central tissue; *cor*, corona; *disk*, retractile disk; *c*, ectodermal groove; *int.* sac, internal sack; *p*, pyriform organ; *pall*, pallial groove.

of the ectoderm results in the ectodermal groove. Near by this groove a mass of cells, the *pyriform organ* (*p.*), forms. Another larval structure, the *calotte* or *retractile disk* (*disk*) provided with motionless sensory cilia, develops at the opposite or aboral pole.

The larva now escapes from the ovicell and commences a short period of free life. Up to this time an alimentary canal is absent, but now changes occur which result in a complete metamorphosis of the larva. By a contraction of the body the sucker is turned inside out and affixes the larva to some foreign object. The aboral side, containing the retractile disk and pallial groove, becomes expanded and is the source of the entire outer covering of the primary zooid. This expansion obliterates the pallial groove and at the same time the corona bends down toward the oral side, forming the *umbrella-shaped* stage of the larva. The vestibule (fig. 2 H *v*) is then formed by the bending down of the edge of the *umbrella* and fusion with the expanded base, forming thus a circular cavity. The walls of the vestibule break up and the cavity merges into the general cavity of the larval interior. The retractile disk and the basal plate of the sucker are now the only remaining larval structures. The former gives origin to the basal part of the wall of the primary zooecium and the latter, after becoming invaginated, develops the ectoderm and endoderm of the primary zooid. Besides this sac the interior of the larva now contains only a mass of undifferentiated tissue derived from the varions structures that have disintegrated. The outer wall of this tissue forms the wall of the primary zooecium and most of the internal mass forms a *brown body*, although a small part seems to form the mesoderm of the zooid. A pouch or diverticulum of the sac forms the rudimentary stomach and intestine and a second diverticulum, the esophagus. These fuse and result in the continuous alimentary canal. In this process of development the brown body remains close to the stomach and is gradually absorbed. After the rudimentary alimentary canal has been formed, the walls of a space in the upper part of the primitive sac cavity become changed into the tentacle sheath, on the base of which appear the tentacles and lophophore. The nerve ganglion is the result of an invagination of the ectoderm in the region between the mouth and anus.

The primary zooid resulting from the metamorphosis of a larva is the ancestor of the entire zoarium and is appropriately called the ancestrula. By a process of asexual reproduction (repeated budding) the entire branching structure with its numerous zooecia results. Although the studies are still imperfect, it is undoubtedly a fact that each family of bryozoa is characterized by its own particular form of larva. This process of budding is discussed in more detail under the general considerations of the Cheilostomata below.

Some zooecia of the adult colony contain no polypide, but in its place is a brown body similar to the one described above in the primary zooecium. This brown body is the remains of a polypide that has undergone degeneration. In such cases the alimentary canal with the lophophore and tentacles have become completely absorbed. Such degenerated polypides may become regenerated with a redevelopment of the organs and reabsorption of the brown body.

## GENERAL CONSIDERATION OF THE CHEILOSTOMATA.

### ENDOCYST AND ECTOCYST.

The skeletal portion of the bryozoid is lined interiorly by a very fine epithelial membrane called the endocyst. This *endocyst* is the essentially living part of the bryozoan. It grows without cessation by the proliferation of its elements, and it secretes the different cuticles. It emits buds of like characteristics but which engender by successive differentation the various organs of the bryozoid.[1]

The first differentation, almost immediate, indeed, is the *ectocyst*[2] (epitheca of Harmer, outer membrane, frontal membrane of Waters). This is generally thin, so thin sometimes that its presence is often doubtful:[3] it has no secreting power.

The calcareous or chitinous secretion forming the "zoarial skeleton" occurs between the ectocyst and the endocyst. This is the only part capable of fossilization. The study of the relations between the skeleton and the living organs of the zoarium forms the essential object of study of paleontologic bryozoology.

The second differentiation of the endocyst is the formation of the *mesenchyme* and of its successive derivatives—polypides, leucocytes, etc.[4] This study is in the domain of zoology exclusively.

The difference of orientation in the proliferation of the endocystal elements is most important. In the Anasca this proliferation occurs only laterally. In correlation early on the budding parts of the zoarium, the endocyst divides in two and provokes a corresponding division of the ectocyst, thus engendering the hydrostatic apparatus called the hypostege (fig. 3).[5]

In the Ascophora the proliferation occurs in two ways—lateral and frontal. In correlation the endocyst develops on both sides of the zoarial skeleton, owing to the emission of frontal buds (fig. 3). Thus in the Anasca the buds are arranged side by side, while in the Ascophora they are placed over each other.

### ZOARIAL BUDDING AND FORMATION OF SKELETON.

The buds of the endocyst are as noted above, lateral or frontal. They evidently secrete lime and occasion secondary calcification.

The lateral buds are:

1. Little developed and leave in fossilization the lateral punctations (=parietal dietellae) of the Adeonidae.

2. More developed, they form the avicularia, the interzooecial vibracula (Adeonidae, Lunulariidae, Onychocellidae).

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[1] 1900. Calvet, Contributions a l'historie des bryozoaires ectoproctes marins, Travaux de l'institut Zoologie de l'Université de Montpellier, new ser., Memoire No. 8, p. 170.

[2] 1886. Joliet, Recherches sur la blastogénèse, Archives de Zoologie experimentale et générale, ser. 2, vol. 4, p. 65.

[3] The word ectocyst is here employed in a different meaning from that of other authors who designated as the "ectocyst" that part of the bryozooid which we call the skeleton.

[4] 1900. Calvet, Travaux de l'Institute Zoologie de l'Université de de Montpellier, p. 239.

[5] 1900. Calvet, Idem, p. 166.

3. Normally developed, they form, according to a process explained by Calvet[1] and by Waters;[2] one, two, rarely three, distal zooecia. Moreover, the coalescence of many buds is often necessary for the formation of a zooecium or of an interzooecial heterozooecium.[3]

Similarly with the frontal buds:

1. Little developed, they form above the *olocyst*, a second deposit the *tremocyst;* their fossil remains are the tremopores.

2. Little developed and only laterally, they form the lateral punctations, the zoarial remains of which are the *areolae* of Harmer, visible in Smittinidae, Escharellidae, etc. They engender the superior endocyst. The latter deposits the *pleurocyst* above the olocyst and form the interareolar costules.

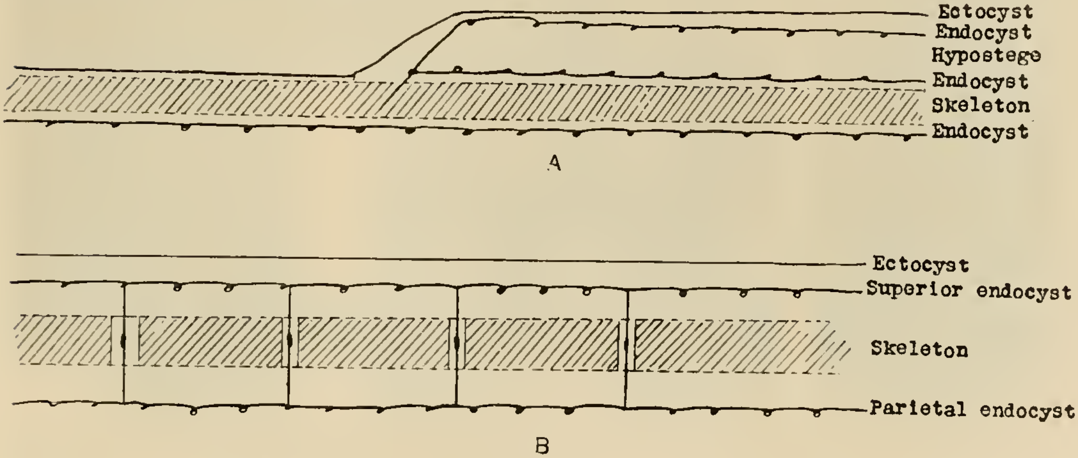

Fig. 3.—Sketch showing proliferation of the endocyst in the Anasca (A) and in the Ascophora (B).

3. Somewhat more developed, they form and secrete the skeletal *tubules* which make up the thick walls of the Acroporidae, Myriozoumidae, Porella, etc.

4. More developed, they engender the frontal avicularia and the radicels.

5. Normally developed, they give rise to the complete zöoecia heaped up on one another without apparent order as in the Celleporidae.

The *gymnocyst* of Levinsen and the *cryptocyst* of Jullien are not special formations; these are special walls defined particularly by their position. The cryptocyst supports the hypostege in the Malacostega; the gymnocyst does not support it at all; these walls may be of olocystal or tremocystal formation. We have preserved these two terms of nomenclature in the exact meaning of their authors.

*Olocyst.*—The olocyst lines the interior of all zooecia, sometimes very thin and transparent and sometimes quite thick. It is formed of scattered elements, quite crowded on the large walls (fig. 4, *A*). When there is a mucro, the elements are grouped in radial rows (fig. 4, *B*). The walls of the mural rims in the Malacostega also have their elements grouped in rows perpendicular to the lines of the zooecial sutures (fig. 4, *C*). The olocystal walls are always smooth (fig. 4, *D*); they are perforated by very small pores when they are surmounted by a tremocyst or a pleurocyst.

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[1] Calvet, Contributions a l'histoire des bryozoaires ectoproctes marins. Travaux de l'Institute de l'Université de Montpellier, new ser., Memoire No. 8, p. 389.

[2] 1906. Waters, Bryozoa from Chatham Island, Annals Magazine Natural History, ser. 7, vol. 17, p. 18.

[3] 1888. Jullien, Mission scientifique du Cap Horn, p. 56.

*Tremocyst.*—The frontal endocystal buds deposit above the olocyst a second calcareous deposit called the *tremocyst;* the pores thus formed are the tremopores; the zooecia, which are provided with them, are tremogastres; the tremopores are funnel shaped or tubular; they are always traversed by mesenchymatous elements.

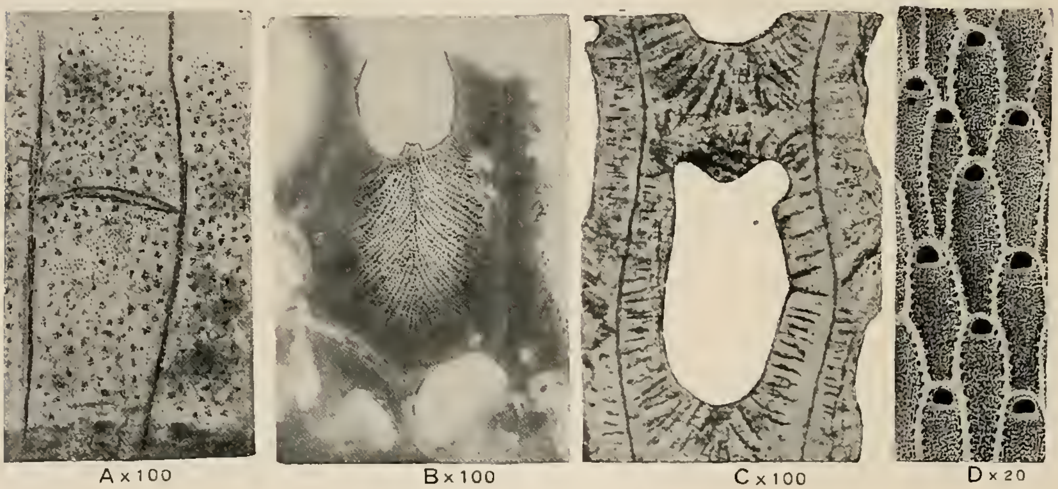

FIG. 4.—Structure of the olocyst.

A. Thin section through the basal wall of *Membraniporidra spissimuralis*, new species, × 100, showing olocyst with crowded elements.

B. Olocyst of *Acanthionella oecioporosa*, new species, × 100, with elements grouped in radial lines.

C. Thin section of *Periporosella tantilla* Canu and Bassler, 1917, × 100, exhibiting elements of olocyst grouped in series around the mural rim.

D. View of interior of *Smittina angulata* Reuss, 1865, × 20, showing the smooth olocyst, perforated by areolae only.

The funnel-shaped tremopores arise from a very small pore perforating the subjacent olocyst (fig. 5, *A*); they become enlarged at the exterior (fig. 5, *B*).

The tubular tremopores or *tubulae* also arise from a small pore piercing the subjacent olocyst (fig. 5, *C*), but the latter is very thin and permits one to see through a circular, white area the base of the tubula itself. At the exterior the tubules have the same diameter (fig. 5, *D*).

Often the tubular pores are united among themselves and the number of the interior pores (fig. 5, *E*) does not correspond to the number of exterior pores (fig.

5, *F*), as in *Porella contracta*, new species, *Enoplostomella synthetica* Canu and Bassler, 1917, etc.

The tremocyst is generally intimately united with the subjacent olocyst; in some cases it is clearly detached (figs. 5, *G*, *H*).

In tangential sections the size of the tremopores depends on the position of the plane of the section. In the vicinity of the olocyst (fig. 6, *A*) the small perforations of the latter are alone visible. At the zoarial surface (fig. 6, *D*) the tremopores have their normal diameter. It is quite frequent to find thus in the same section the olocyst and the tremocyst (fig. 6, *B*). The reticulations (fig. 6, *C*) which seem to unite the tremopores among themselves are evidently the intersections of the different calcifications.

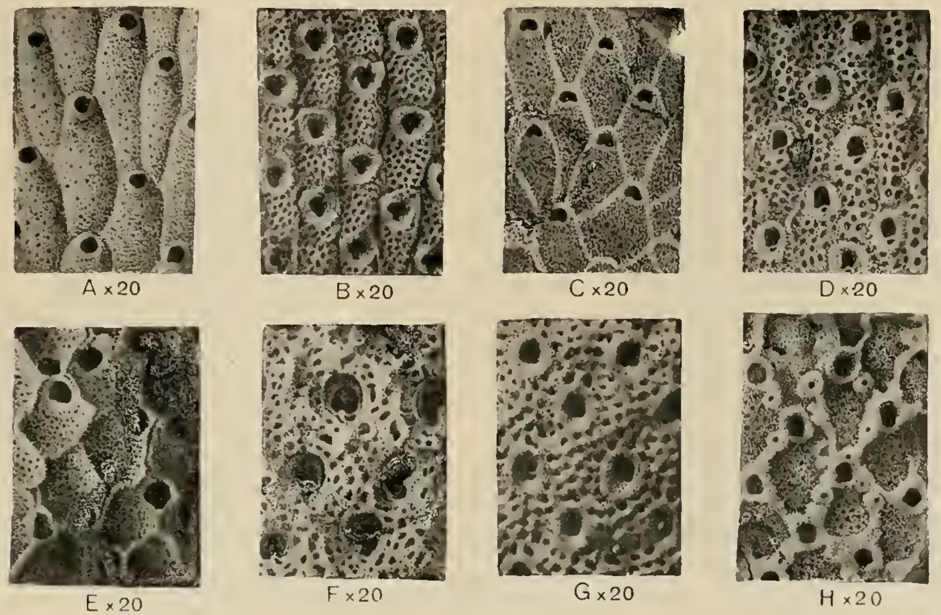

FIG. 5.—Structure of the tremocyst.

A, B. *Stomachetosella crassicollis* Canu and Bassler, 1917. Orifices of the funnel-shaped tremopores as seen in the interior (A) and at the exterior (B). × 20.

C, D. *Porella crassoparies*, new species. Orifices of the tubular tremopores, × 20, in the interior (C) and at the exterior (D).

E, F. *Enoplostomella synthetica*, new species. Views, × 20, showing coalescence of the tremopores, the number of which in the interior (E) does not correspond with the number at the exterior (F).

G, H. *Hippodiplosia magniporosa*, new species, × 20. Views showing that the tremocyst (G) may be detached from the subjacent olocyst (H).

*Tubules.*—The tubular tremopores, when they are quite long, constitute the *tubulae*. They are frequent in *Myriozoum*, *Acroporidae*, *Porella*, etc. Waters and Levinsen have carefully studied these structures. "These tubes have a disk near the junction with the zooecium, and in the middle of the axial tubes, which are often very long, there are similar disks (fig. 7, *A*). The shell structure is terminated by a membrane (*b*) (fig. 7, *B*) perforated by these pores; but over this, as in the greater part of the cheilostomatous bryozoa, there is another fairly thick and somewhat chitinous membrane (*a*) (fig. 7, *B*) continuously covering the zoarium. The cell contents of the tubes attach themselves to this by delicate threads" (fig. 7, *C*) (Waters, 1900). Levinsen in 1909 demonstrated that these "delicate threads" were formed of mesenchymatous tissue.

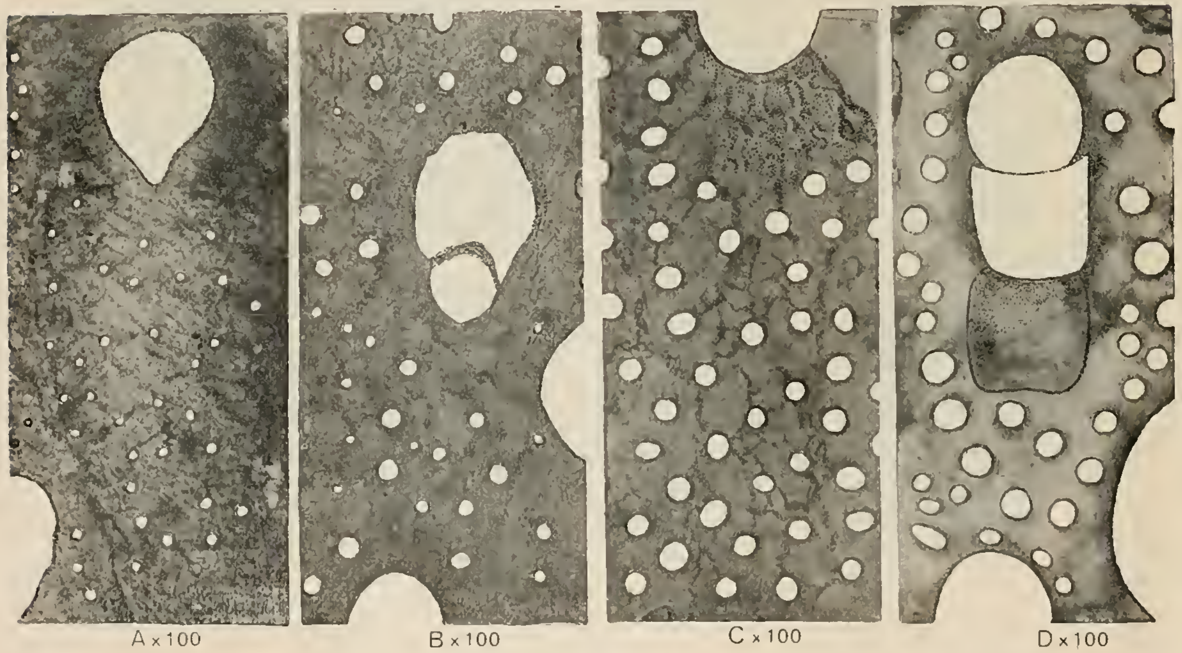

Fig. 6.—Microstructure of the tremocyst and olocyst.

A. *Stomachetosella crassicollis* Canu and Bassler, 1917. Tangential section, × 100, at the level of the subjacent olocyst; the inner orifice of the tremopores is visible.

B. *Porella crassoparies*, new species, × 100. Tangential section a little distant from the olocyst. Olocyst and tremocyst are visible.

C. *Hippomenella rotula*, new species, × 100. Tangential section through the tremocyst. Areolae and tremopores are of the same nature.

D. *Porella denticulifera*, new species, × 100. Tangential section through the orifices of the tremopores.

*Pleurocyst.*—The areolae are only lateral tremopores; they are the remains of endocystal buds and are traversed by mesenchymatous fibers. The superior endocyst continues its calcareous deposit as the *pleurocyst;*[1] the lateral arrangement is the cause of special manifestations quite different from those of the tremocyst.

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[1] This deposit Harmer and Levinsen attribute entirely to the ectocyst.

The calcareous secretion is first active about the areola (fig. 8, *A*), but it extends rapidly over all the frontal.

The pleurocystal deposits are often granular (fig. 8, *B*) but they generally form interareolar costules (fig. 8, *C*) so frequent in *Smittina*, *Hippomenella*, etc.

The porous pleurocyst is more rare (fig. 8, *D*, *E*); the pores are unequal, irregular, and arise from the irregular union of the primitive granulations. Contrary to the tremopores they do not perforate the subjacent olocyst (fig. 8, *D*).

The pleurocyst is easily detached from the olocyst (fig. 8, *F*).

The areolae appear clearly in the tangential sections when made at the level of the olocyst (fig. 8, *G*). Made on the exterior plane the interareolar costules alone appear (fig. 8, *H*).

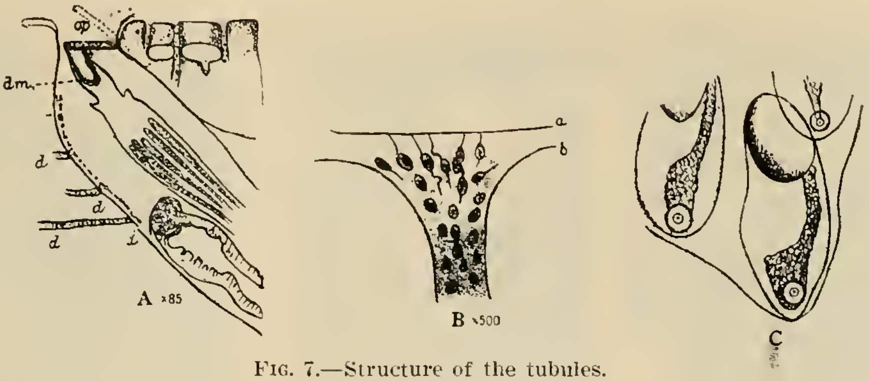

FIG. 7.—Structure of the tubules.

A–C. *Myriozoum subgracile* D'Orbigny, 1852. A. Section, × 85, through polypide showing the disks (*d*) in the pore tubes, diaphragm (*dm*), and the operculum (*op*), with dotted lines to show the position when partly open. (After Waters, 1900.)

B. End of tubula, × 500, showing the covering integument *a* (ectocyst) and the inner one, *b*. (After Waters.)

C. Each of the tubes contains a mesenchymatous tractus, and is, at its proximal part, furnished with a uniporous septula. (After Levinsen, 1909.)

Made in an intermediate plane they show some radial reticulations which are evidently the intersections of the different calcifications (fig. 8, *I*).

On recent bryozoa these three fundamental deposits are subject to some interesting variations, the study of which was only begun in 1909 by Levinsen.[1] We refer the reader to his work, for on the fossils these variations are quite invisible.

*Septulae and Dietellae.*—The mesenchymatous fibers pass from one zooecium to another by small parietal pores called *septulae*. The septulae are uniporous (fig. 9, *A*) or multiporous (fig. 9, *B*) (=rosette-plates of authors). On the fossils the septulae are rarely visible. The multiporous septular disks leave a large pore often visible exteriorly, as in the Membraniporae. For shortness in this monograph we called these structures also septulae.

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[1] 1909. Levinsen, Morphological and Systematic Studies on the Cheilostomatous Bryozoa, pp. 1–7.

The mesenchymatous fibers before passing through the *septulae* traverse in the proximal part only of the zooecia small lateral chambers called *dietellae* (=pore chambers of English authors) (fig. 9, *C*, *D*). These structures persist in fossilization only if their walls are thick; they may be discovered by abrasion of the frontal

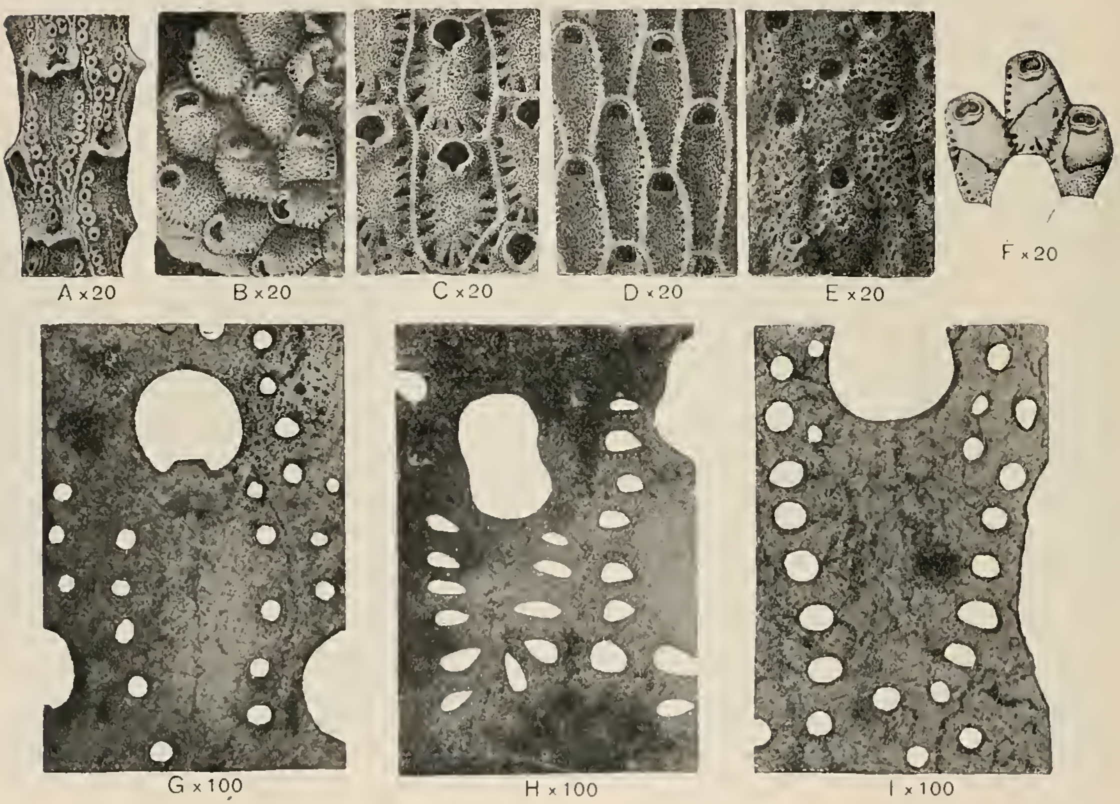


Fig. 8.—Structure of the pleurocyst.

A. *Ochetosella jacksonica* Canu and Bassler, 1917, × 20. The calcification is active around the areolae.

B. *Mucronella granulosa*, new species, × 20. Granular pleurocyst.

C. *Smittina grandifossae*, new species, × 20. Pleurocyst with interareolar costules.

D, E. *Smittina angulata* Reuss, 1865, × 20. Porous pleurocyst. In the interior the olocyst is perforated only by areolae (D).

F. *Mucronella variolosa* Johnston, 1838, × 20. The pleurocyst is detached from the subjacent olocyst.

G. *Smittina reticuloides*, new species, × 100. Tangential thin section in the vicinity of the olocyst.

H. *Smittina reticuloides*, new species, × 100. Tangential thin section through the interareolar costules.

I. *Hippomenella rotula*, new species, × 100. Tangential thin section through the pleurocyst.

(fig. 9, *E*). In certain species (see *Membrendoecium duplex*) some of the zooecia are without dietellae.

## FUNCTIONS OF REPRODUCTION.

### LARVA.

The great obstacle in bryozoology is the lack of knowledge of the larval system, for studies on this subject are really very incomplete. Moreover, any attempt at a general classification is impossible at present, because each family is undoubtedly characterized essentially by its larva. Nevertheless we are able to utilize with success the studies on this subject made by Smitt in 1865, Barrois in 1877, and Calvet in 1900. In our text figures we have reproduced illustrations of the larva wherever known.

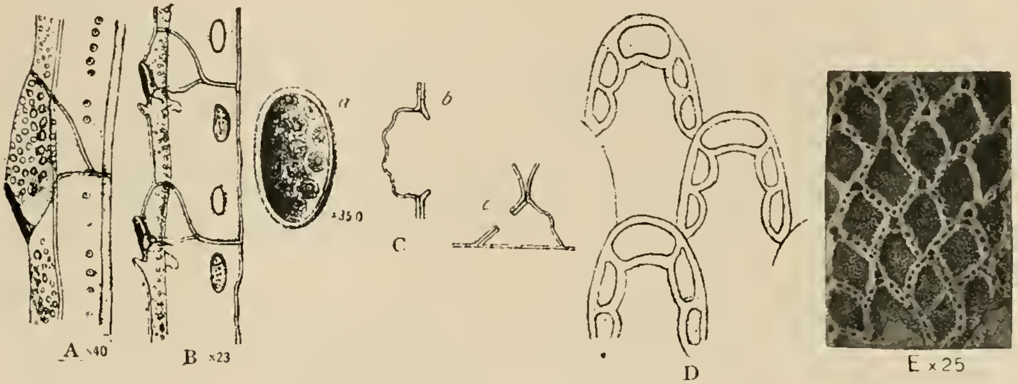


Fig. 9.—Septulae and dietellae.

A. Uniporous septulae of *Hippopodina fegeensis* Busk, 1884, × 40.

B. Multiporous septulae or disk septulae of *Cheilopora sincera* Smitt, 1877, × 25. (A, B, after Levinsen, 1909.)

C. *Hippodiplosia pallasiana* Moll, 1803; *a*, multiporous septula, × 350; *b*, schematic longitudinal section through a multiporous septula; *c*, schematic longitudinal section through a dietella (After Levinsen, 1909.)

D. Dietellae of *Callopora lineata* Linnaeus, 1768. (After Norman, 1903.)

E. Dietellae of *Trypostega venusta* Norman, 1864, obtained by abrasion of the frontal of a specimen from the Vicksburgian at Byram, Mississippi.

### OVICELLS.

The eggs are transformed into embryos and into larvae within cavities of incubation. These cavities, when they are visible, are called *ovicells*.

*Nonovicelled zooecia.*—A large number of species of Cheilostomata show no ovicells and nothing on the exterior reveals their mode of reproduction. Some are oviparous and expel their eggs by an intertentacular organ (Electrinidae). Others develop their embryos in the tentacular sheath (Cyclostomata). There is quite an important group in which the cavity is a membranous sac attached to the subdiaphragmatic region of the tentacular sheath; often the female zooecia are identical with the others (*Lepralia cucullata* Busk, 1852, *Beania magellanica* Busk, 1850, *Diplodidymia* Reuss, 1867); but often also the female zooecia have a special form suitable for their function (=gonoecia of the Adeonidae and Catenicellidae).

In actual experience it is necessary to have a very large number of specimens to establish that any fossil species entirely lacks ovicells, for these organs are very fragile.

*Nature of the ovicells.*—Most of the Cheilostomata have some visible ovicells. Their nature is not always peculiar to a particular larval system. Nevertheless the *endotoichal* ovicell appears peculiar to the Cellariidae, the *recumbent* ovicell to the larvae of the Phylactellidae and the Conescharellidae and the *peristomial* ovicell to the larvae of the Tubucellariidae. In all other cases many very different systems of larvae may be developed in ovicells apparently identical; these latter are *endozooecial* or *hyperstomial.*

The *endozooecial* ovicells are formed by the distal portion of the zooecium; in certain genera they are separated from the zooecium by a fold of the wall (Flustridae, Hippopodinidae, Farciminariidae, Onychocellidae, etc.).

The *hyperstomial* ovicells are placed on the distal zooecium. A very important group among them has their orifices closed by a distinct operculum formed for the most part by the ectocyst itself; this is the group of the *Aneucleithriens.* In practice, on the fossil forms, such ovicells are recognized by their frontal which does not hide the apertura; seen in profile, their orifice is perceptibly perpendicular to the apertura.

A second group has the orifice always closed by the operculum; this is the group of the *Cleithriens* (*Micropora*, etc.). Practically, on the fossils these are recognized as follows: First, their frontal partially covers the apertura; second, seen in profile, their orifice is oblique to the apertura; third, the common orifice is identical and of the same size in all the ovicelled zooecia.

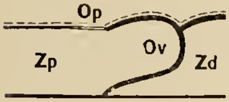
The third group, that of the *Subcleithriens*, is intermediate between the two preceding; the operculum closes the ovicell only in opening. This opercular function is certainly intended to protect the passage of the eggs. On the specimens deprived of their opercula, the distinction is very subtle, especially as the closing is not always perfect. Practically on the fossils, subcleithrien ovicells are recognized by the following points: First, their frontal partially covers the apertura; second, seen in profile their orifice is oblique to the apertura; third, the common orifice is identical with the true orifice; fourth, the common orifice is identical with the apertura of the unovicelled zooecia.

When the operculum is fragile the ovicell is more or less deeply imbedded in the distal zooecium; the apertura is oblique; the ovicell opens into a small, free space called the *locella* (Peristomellæ).

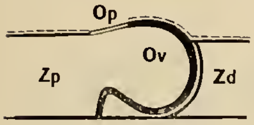
Again, when the operculum is fragile the frontal becomes much thickened and the ovicell imbedded in the distal zooecium opens into the peristomie thus formed. The apertura, more or less visible and oblique, is placed at the base of this peristomie (Smittinidae). The exterior orifice is therefore never closed by the operculum and it is very irregular.

Figure 10 gives a summary of the terminology now applied to the ovicells.

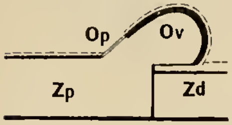
*Structure of the ovicells.*—In 1886 Jullien discovered that the ovicell was formed by two walls; the internal wall or "sparganile" is thin, fragile, and hyaline; the external wall, or "coites," is thicker, often incomplete, proceeding from the peristome and sometimes intimately joined to the subjacent wall. In 1903 he described the peculiarities of these two walls for each species.



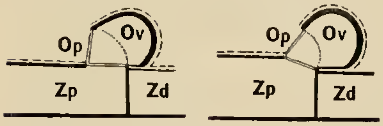
ENDOZOOECIAL OVICELL. The ovicell is within the zooecium itself. The operculum closes both zooecium and ovicell.



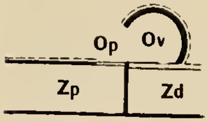
SEPARATED ENDOZOOECIAL OVICELL. A fold of the zooecial wall separates the ovicell from the zooecium.



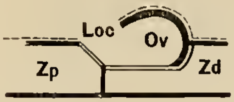
CLEITHRIAN HYPERSTOMIAL OVICELL. The ovicell is placed on the distal zooecium and opens below the operculum. The operculum always closes the ovicell and zooecium. There is only one aperture.



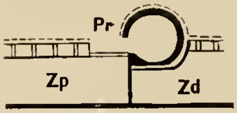
SUBCLEITHRIAN HYPERSTOMIAL OVICELL. The operculum in opening closes the ovicell. There are two apertures.



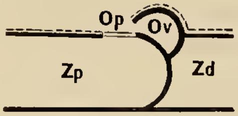
ANEUCLEITHRIAN HYPERSTOMIAL OVICELL. The ovicell opens above the operculum.



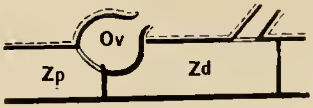
DEEP ANEUCLEITHRIAN HYPERSTOMIAL OVICELL. The ovicell is placed in a deep cavity of the distal zooecium. The operculum is very oblique and operates in a chamber or locella.



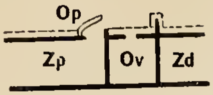
PERISTOMIAL ANEUCLEITHRIAN HYPERSTOMIAL OVICELL. The ovicell opens above the operculum in the peristomie.



INDEPENDENT (RECUMBENT) ANEUCLEITHRIAN HYPERSTOMIAL OVICELL. The ovicell is placed on the distal wall of the zooecium itself.



PERISTOMIAL OVICELL. The ovicell is formed by a great enlargement of the peristomie.



ENDOTOICHAL OVICELL. The ovicell is separated from the zooecium. Its orifice is removed from the aperture and placed on the same plane.

FIG. 10.—Diagrams showing structure and terminology of ovicells of Cheilostomatous Bryozoa. *Loc,*=locella; *Op,*=operculum; *Ov,*=ovicell; *Pr,*=peristomie; *Zd,*=distal zooecium; *Zp,*=proximal zooecium. The thin broken line indicates the membranous ectocyst, while the thin double line represents the operculum.

In 1909 Levinsen maintained that the ovicell is formed of two membranes—the *endooecium* and the *ectooecium*. According to the family one or the other is calcified. Between them there often is an intermediate layer which he called the *cryptocyst*; finally, in certain special cases the ovicell is covered by an *ooecial cover*, independent of the two aforesaid membranes.

The observations of Jullien appear to us more exact. In fact, almost always, the formation of the ovicell is identical with that of the frontal. There are, however, some exceptions (*Smittina*, *Umbonula*). Moreover, all the observations of Levinsen are explained rather well by the manifestations of the three calcareous deposits previously noted—olocyst, tremocyst, and pleurocyst. In all of our studies we have not once found it necessary to have recourse to his theory.

*Passage of the eggs.*—The eggs are formed in the general cavity, but they do not develop there. They pass into the ovicell, where, by successive segmentation, they are transformed into embryos and into larvae. This passage is very delicate (fig. 11, *A*); it is assured by the tentacular sheath or by a sacciform expansion of the endocyst (fig. 11, *B*); it is protected by some arrangements as varied as remarkable and of which the principal are the following:

1. The functioning of a special operculum to the ovicell (fig. 11, *C*).
2. The functioning of the zooecial operculum itself, which closes the orifice of the ovicell either always or only during the passage and the incubation. The operculum is then strongly chitinized to serve for protection (fig. 11, *D*).
3. The development by thickening of the walls of a *peristomie* into which the orifice of the ovicell opens (fig. 11, *E*). The aperture is deep and closed by a fragile operculum. The exterior orifice of the peristomie is the *peristomice;* it is irregular and surrounded by the *peristome.*
4. The obliquity of the apertura and the imbedding of the ovicell in the distal zoöecium forms a very small chamber or *locella* sufficiently protected; moreover, the mucro, the labial appendages, and spines complete this little cell (fig. 11, *F*).

*Fixation of the larva; Ancestrula.*—The larva of the cheilostomatous bryozoa after some hours of life in liberty becomes fixed on a substratum and then grows into the zoarium. The first zooecium is the *ancestrula.* In the Malacostega this ancestrula is analogous to the other zooecia, but smaller. In the Anasca there is more variety. More often the ancestrula is a small zooecium identical with the others. Frequently there are some interesting variations which have been studied by the zoologists.

On fossils the ancestrula is very fragile and is very often broken. We have been able nevertheless to figure a score of specimens almost always identical with the zooecia. Only *Puellina radiata* Moll, 1803, *Rhamphostomella simplex*, new species, and *Smittina puncturata*, new species, have given membraniporoid or modified ancestrulae.

The larvae of the bryozoa are not fixed at hazard; they chose their own substratum, which is surprising. The Lunulariidae choose a grain of sand; others. shells and stones; others, marine algae; and still others live only on a special species of mollusca or bryozoa (symbiosis). The reader will find in the course of this monograph many interesting cases that we have noted. When these observations are sufficient they will permit us to reconstruct the submarine depths and their biologic conditions.

The transformation of the larva into the ancestrula has been the subject of the histological works of Barrois, 1877, and of Levinsen, 1900. The zoarial budding has been the subject of works of Haddon, 1883; Davenport, 1891; Calvet, 1900; Waters, 1906, etc.

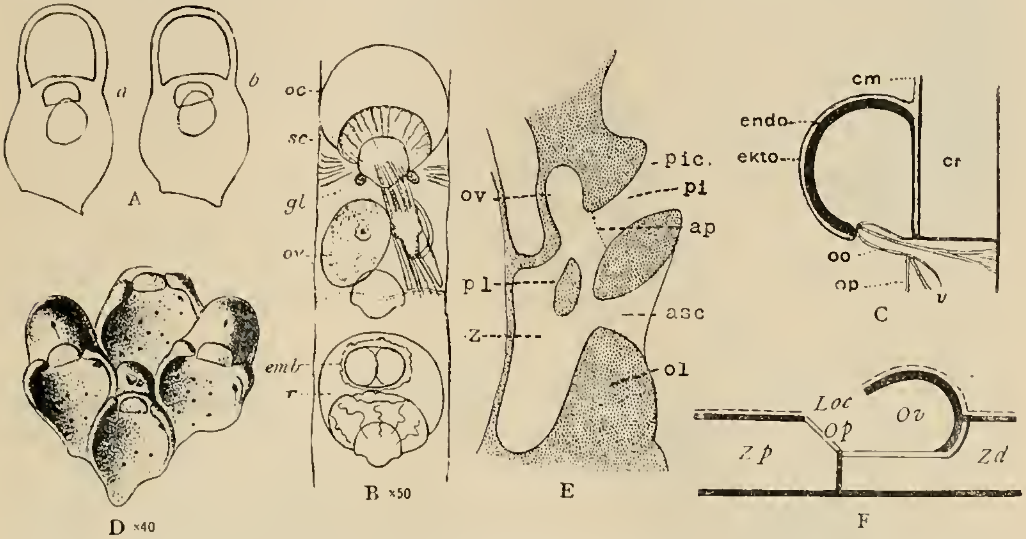


FIG. 11.—Passage of the eggs.

A. *Lepralia martyi* Joliet, 1877. *a.* Egg commencing to approach the entrance of the ovicell. b. The same, some hours after and in which the egg is already strongly engaged in the passage of the ovicell. (After Joliet, 1877.)

B. *Schizopodrella* (*Schizoporella*) *nivea* Busk, 1884, × 50. A sac-like structure (*sc*) is shown at the base of each ovicell (*oc*), but of the numerous muscles in this sac only about half of those in focus are drawn. It seems that the ovum (*ov*) passes into this sac which is then ruptured (*r*) and the ovum is pressed forward into the ovicell, where it segments. The small oral glands (*gl*) are shown. *Emb*=embryo. (After Waters, 1913.)

C. *Schizopodrella* (*Schizoporella*) *unicornis* Johnston, 1847. Operculum of the ovicell. (After Levinsen, 1909.) It is probable that this figure is only a schematic one after a longitudinal section on the order of figure B. *cm*, covering membrane; *cr*, cryptocyst; *ekto*, ectocyst; *endo*, endocyst; *oo*, ooecial operculum; *op*, operculum; *v*, vestibulum.

D. *Micropora coriacea* Esper, 1797, × 40. The operculum closing the ovicell protects the passage of the eggs. (After Levinsen, 1909.)

E. *Gastropella ventricosa* Canu and Bassler, 1917. Sketch showing development of a peristomie above the ovicell.

*ap*, apertura; *asc*, ascopore; *ol*, olocyst; *ov*, ovicell; *pi*, peristomie; *pic*, peristomice; *pl*, pillar; *z*, zooecium.

F. Section through ovicell showing the *locella* protecting the passage of the eggs.

*loc*, locella; *op*, operculum; *ov*, ovicell; *zd*, distal zooecium; *zp*, proximal zooecium.

## HYDROSTATIC FUNCTIONS.

*Zooecial hydrostatic relations.*—The discovery of the zooecial hydrostatic system of the Cheilostomata was made by Jullien in 1888. It explained the greater

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[1] 1888. Jullien, Sur la sortie et la rentrée du Polypide dans les zooecies chez les Bryozoaires Cheilostomiens monodermiés, Bulletin Société Zoologique France, vol. 13, pp. 67, 68.

part of the opercular and muscular manifestations for a long time remaining absolutely enigmatical.

In the Ascophora the polypide can emerge from the zooecium only if an equal volume of water compensates this extrusion. For this purpose a sac called the *compensatrix* is placed under the dorsal. This sac communicates with the apertura and occupies a part of the zooecial length; to it *parietal muscles* are attached. At the moment of extrusion of the polypide, the muscles contracting, enlarge the compensatrix, the operculum in opening frees its orifice and a minute drop of water penetrates into it, thus compensating for the polypide.

The entrance of the water into the compensatrix is a function which is exercised in many ways, indicated by the frontal and by the operculum.

*Operculum.*—The operculum is a quite small chitinized organ, closing at the same time the apertura and the compensatrix. It bears only a trace of occlusor muscles (=retractor), because the polypide itself in emerging pushes open the operculum.

.The anterior part, or *anter*, closes the orifice of extrusion of the polypide, or *porta;* the posterior part, or *poster*, closes the orifice of the compensatrix, or *vanna.*

The principal cases of this function of the introduction of the water into the compensatrix are mentioned below.

If the orifice of the compensatrix be very small, the latter is closed by a small valve of the operculum, to which a small cleft or fissure of the apertura, the rimule, corresponds (Schizoporellae). This operculum is chitinized and rigid; it moves on two condyles and bears the marks of two feeble occlusor muscular bundles (figs. 12, *A-C*).

If the orifice of the compensatrix be large, it is closed by a large valve of the operculum, to which corresponds a large vanna, whose size is inversely proportional to the length of the compensatrix. The hydrostatic effort being considerable, the operculum is chitinized and rigid and sways on two cardelles; it bears two lateral bands for the attachment of the powerful occlusor muscles (*Hippoporina*) (figs. 12, *D-F*).

When the compensatrix is attached to the operculum the latter is thin, fragile, semilunar, with a proximal border straight or convex. It does not always exactly cover the apertura, whose form is nevertheless almost identical but with a proximal border always concave. The orifice not covered by the operculum is that of the compensatrix; it is protected by a *lyrula* or a *mucro*, and, according to the hydrostatic pressure, it moves on two condyles (*Smittina*) (figs. 12, *G-I*).

In order to diminish the arrival of the water there is often a small peristomial canal, or *pseudorimule*, or *rimule-spiramen*, or a *spiramen* opening into the peristomie.

The form of the operculum is therefore identical with that of the apertura; but the latter on the fossils is not always visible exteriorly, for it may be hidden by the

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[1] Levinsen in 1909, in his Systematic and Morphological Studies on the Cheilostomatous Bryozoa, pp. 37–46, published a very complete study on the operculum.

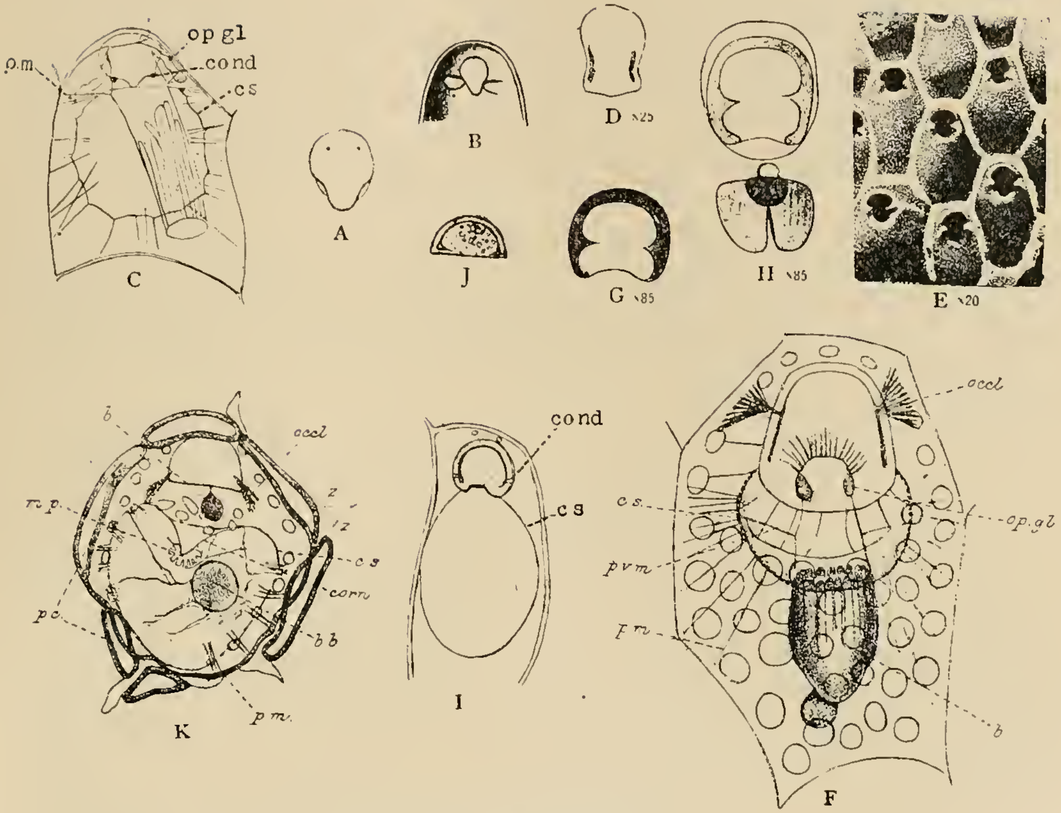

FIG. 12.—Hydrostatic functions.

A. Operculum of *Dakaria* (*Schizoporella*) *gelida* Waters, 1903.

B. Interior of *Dakaria* (*Schizoporella*) *gelida* Waters, 1903. (After Waters.)

C. Compensatrix of *Phonicosia sanguinea* Norman, 1868. (After Harmer, 1902.)

D. Operculum of *Hippoponella hippopus* Smitt, 1867. (After Waters, 1900.)

E. Interior of *Hippoporella multilamellosa*, new species, × 20.

F. Compensatrix of *Hippodiplosia pallasiana* Moll, 1803. (After Harmer, 1902.)

G. Operculum of *Smittina tripora* Waters, 1903, × 85.

H. Apertura of *Smittina tripora* Waters, 1903, × 85, with operculum and below it the avicularian glands with the mandible above the glands.

I. Compensatrix of *Smittina trispinosa* Johnston, 1837. (After Harmer, 1902.)

J. Operculum of *Microporella malusi* Audouin, 1826. (After Waters, 1878.)

K. Compensatrix and ascopore of *Microporella malusi* Audouin, 1826. (After Harmer, 1902.)

*b*, polypide bud; *bb*, brown body; *cond*, condyle; *corn*, cornicula; *c. s*, compensatrix; *m. p*, ascopore (=median pores); *occl*, occlusor muscles of operculum; *op. gl*, opercular glands; *p. c*, dietellae (=pore chambers); *p. m*, parietal muscles; *p. v. m*, parietovaginal muscles; *z*, zooecia.

mucro, by the avicularia, or at the base of the peristomie. The only practical means of recognizing the apertura is the examination of the interior of the zooecium, obtained by abrasion of the basal wall. Each time that it is possible one should not hesitate to make this preparation. It should be noted further that many of the apertures are oblique and that their true form can be observed or drawn only by a suitable tilting of the specimen, placing the plane of the apertura parallel to the objective. In some rare species the operculum does not correspond exactly to the apertura; in such cases it is evident that for the paleontologist the problem can not be solved.

According to Smitt, Hincks, and Jullien, the form of the operculum characterizes the families. Some results obtained by the study of embryology do not permit this theory to be held any longer. In the same family characterized by the same larva the entrance of the water into the compensatrix may occur in diverse manners. It is indubitable, however, that the form of the apertura is an excellent generic character.

*Ascopore.*—The compensatrix does not always open into the apertura, but it may open exteriorly on the frontal by an *ascopore* (micropore). The operculum is then semilunar with a straight proximal border (figs. 12, *J*, *K*).

*Hypostege.*—In the Anasca the hydrostatic system is external, as it is formed of a cavity situated between the cryptocyst and the ectocyst. The cryptocyst is that part of the skeleton immediately in contact with the endocyst. The parietal muscles are attached to the cryptocyst when the latter is flexible (Flustridae); they are attached to the ectocyst when it is calcified (Onychocellidae, Steganoporellidae, etc.). Here the sea water can not penetrate into the hypostege, for there is no operculum, but a simple opercular valve intimately joined to the ectocyst. But certainly there is a liquid in the hypostege; according as it is introduced or expelled, it serves as a compensation to the polypide.

All the zooecial hyposteges evidently communicate with each other and form a zoarial hydrostatic system. The simultaneous extrusion of all the polypides of the same zoarium is therefore impossible; this is a notable inferiority in the internal hydrostatic system of the Ascophora.

*Zoarial hydrostatic system.*—Calvet designated as the hypostege the space included between the ectocyst and the cryptocyst. We believe that it is necessary to make a distinction between this zoarial hypostege and the zooecial hypostege described by Jullien and quite visible on a very large number of Anasca. It is evident that all the hyposteges communicate with each other under the ectocyst.

In many species (Lunulariidae) with a chitinized and thick ectocyst, this zoarial hydrostatic system is quite important.[1] It permits adaptation to diverse aquatic conditions and functions according to the principle of Archimedes.

The species which creep on algae have small tuberosities. The flexible and extensile ectocyst alone is fastened on the algae and the small tuberosities glide over this membrane. This arrangement avoids the disjunction of the zooecia with rigid skeleton in consequence of the inevitable growth of the substratum.

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[1] 1915. Canu, Le systeme hydrostatique zoarial des Bryozoaires cheilostomes, Bulletin Société Géologique France, ser. 4, vol. 15, p. 21.

The species which creep over very delicate algae have some longer tuberosities. They have as their object the withdrawal of the ectocyst from the cryptocyst, to augment the volume in order to diminish the weight and thus to be able to grow on the algae, without making it bend over, risking an overturn. The reader will find in the course of this monograph some very curious variations of the zoarial hydrostatic system which it is needless to mention here.

*Use of the vibracula.*—Either attached by some radicels or placed under the algae, the Lunulites, notably because of their turbinate form, are in a very unstable position; they upset at the least current of water. The animal maintains its normal position by the aid of long articulated filaments called *vibracula*. These are then objects for stabilization somewhat analogous to the balancing rod of a rope dancer.

These vibracula have a like function in many articulated genera; *Scrupocellaria*, *Bicellaria*, *Caberea*, etc., parasites on algae, movements of which constantly compromise the equilibrium of their zoaria.

## FUNCTIONS OF RELATION.

*Avicularia.*—The avicularia are heterozooecia formed of a small cell or avicularian cavity and of a mobile mandible.

The avicularian cavity is constructed like one of the adjacent normal zooecia. It contains an endocyst, an ectocyst, a zoarial hypostege, leucocytes, a mesenchymatous plexus, and mandibular muscles. The only difference is in the abortion of the polypide, which is reduced to the state of polypidian rudiment (= peculiar body, ciliated organ). The mandibular muscles are powerful; there is an *elevator* bundle (=abductor) of the mandible and an *occlusor* bundle (=depressor, adductor, retractor). The avicularian cavity is terminated by a *beak*.

"The mandibles of the avicularia are symmetrical and have the closing muscles attached by one or two long tendons. They all have a straight proximal edge, and work from this straight base either against the calcareous bar, or, in case this is not complete, then from two teeth." (Waters, 1913.) Avicularian glands may occur.

The function of the avicularia is not yet known. It appears to be in relation with the hydrostatic system. (Smittinidae, *Metradolium obliquum*, new species, etc.) Many times the avicularia occur with the ovicell. They are always placed in the vicinity of the apertura, and Canu considers them as being of service in alimentation. Waters thought that they were organs of oxygenation. "The polypide dies down from time to time, and a colony may be left with few or no active polypides. It remains in vigor, through the avicularian organs retaining vitality, and thus keeping the protoplasmic parenchyme in indirect communication with the external surroundings. The avicularia have protoplasmic [mesenchyma-

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[1] See D'Orbigny, Bryozoaires crétacés, pl. 719, figs. 7, 15; pl. 721, figs. 3, 7, 11; pl. 723, fig. 12; pl. 731, fig. 7, etc. The presence of zoarial tuberosities is not necessarily a proof of hydrostatism, for these same tuberosities can exist in zoaria composed of many superposed lamellae.

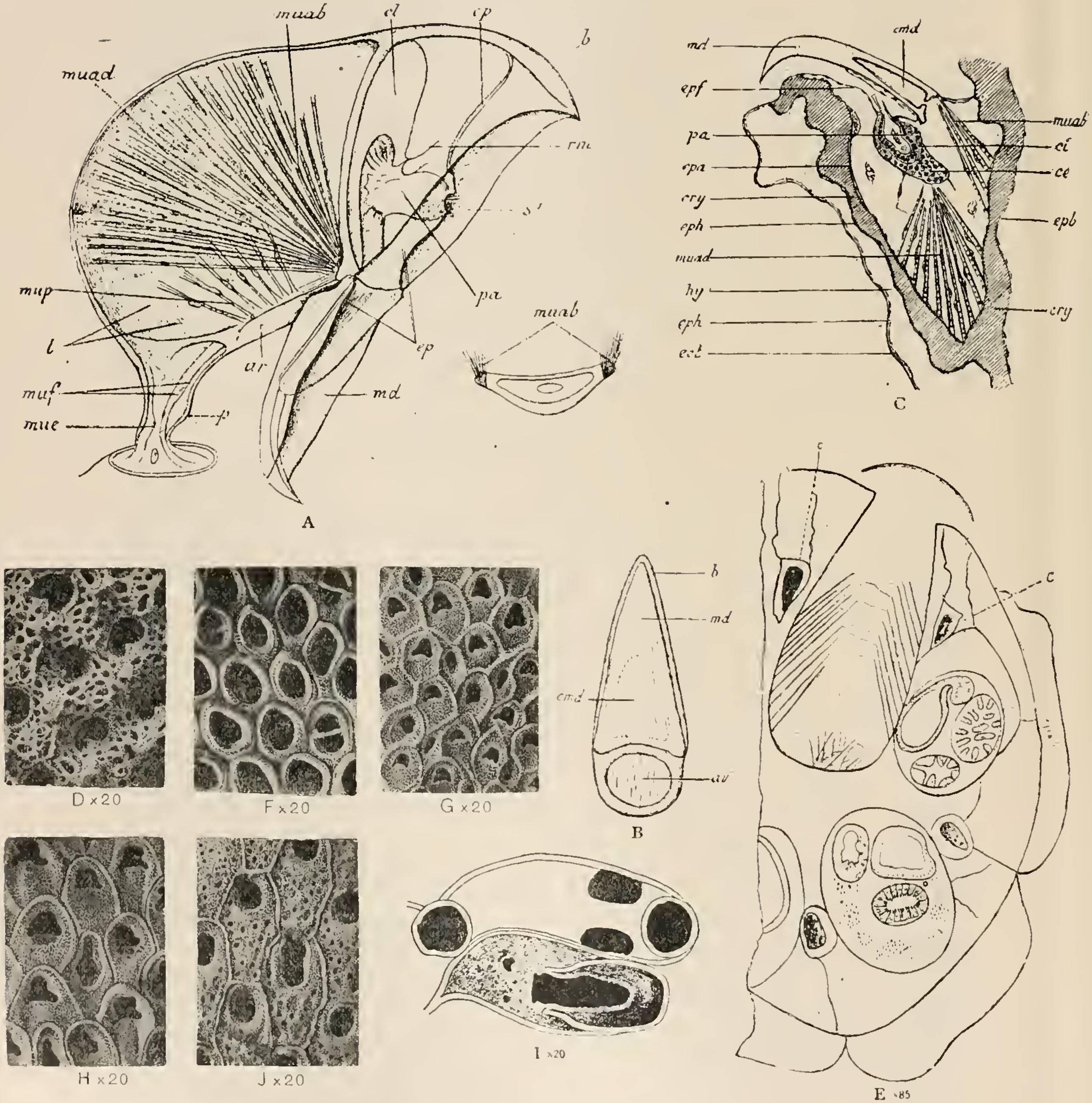
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FIG. 13.—Structure of the avicularium.

FIG. 13.—Structure of the avicularium.

A. Avicularium of *Bugula sabatieri* Calvet, 1900. (After Calvet.)

*ar*, area.
*b*, beak.
*cl*, partition.
*ep*, epidermis.
*l*, leucocytes.
*md*, mandible.
*muab*, mandibular abductor muscle.
*muab'*, basal face of the mandible, where the avicularium shows the insertion of two abductor muscles.
*muad*, mandibular adductor muscle.
*mue*, extensor muscle of the avicularium.
*muf*, flexor muscle of the avicularium.
*mup*, parietal muscles.
*p*, peduncle.
*pa*, polypidian rudiment.
*rm*, mesenchymatous network (or plexus).
*s*, cilia of the polypidian rudiment.

B. Exterior portion of an immersed avicularium; *ar*, membranous area; *b*, beak; *cmd*, mandibular cavity; *md*, mandible.

C. Longitudinal section of the avicularium of *Schizopodrella* (*Schizoporella*) *linearis* var. *hastata* Hincks, 1880. (After Calvet, 1900.)

*ce*, external layer of the ciliated organ.
*ci*, internal layer.
*cmd*, mandibular cavity.
*cry*, cryptocyst (skeleton).
*ect*, ectocyst.
*epa*, avicularian epidermis.
*epb*, frontal epidermis of the bryozoid.
*epf*, facial epidermis.
*eph*, hypostegial epithelium.
*hy*, hypostege.
*md*, mandible.
*muab*, mandibular abductor muscle.
*muad*, mandibular adductor muscle.
*pa*, polypidian rudiment (=ciliated organ).

D. *Enoplostomella synthetica*, new species, × 20, showing tremopores transformed into avicularia.

E. Section of *Cellaria dennanti* MacGillivray, 1887, showing the large avicularian chamber and the intermediate zooecia (*c*). (After Waters, 1904.)

F. Interzooecial avicularia, with pivot, of *Grammella crassimarginata* Hincks, 1881.

G. Curved onychocellarium of *Onychocella laciniosa*, new species, × 20.

H. Straight and symmetrical onychocellarium of *Floridina antiqua* Smitt, 1872, × 20.

I. Reticulocellarium of *Thalamoporella granulata* Levinsen, 1909. (After Osburn, 1914.)

J. Avicularian zooecium of *Porella planulata*, new species, × 20.

tous] threads passing to the peculiar body, and the vitality of the colony will, both in times of full and diminished vigor, be increased by the avicularia; for the constant snapping of the mandibles often continues when the polypides are not extending themselves out the zooecia, and, as before said, even when there are few or no polypides. Sections often show the avicularia in unchanged conditions, when the zooecia only contain hystolysed remains of polypides." (Waters, 1904.)

The avicularia are not protective organs, as former authors believed; in fact, they are developed and much elongated in the most protected part of the zoarium. This phenomenon is of constant occurrence in the Cellepores.

The avicularia develop very often in the place of the tremopores and areolae; the zoologists have figured many examples of them; we ourselves have been able to observe such occurrences on *Schizopodrella linea* Lonsdale, 1845, and on *Enoplostomella synthetica* Canu and Bassler, 1917.

There are three principal kinds of avicularia—articulated, frontal or immersed, and interzooecial.

The articulated avicularia exist on the articulated zoaria; they are often very complicated and quite perfected organisms (fig. 13, *A*).

*Frontal or immersed avicularia.*—These are quite variable; it is always possible to distinguish the corneo-chitinous mandible, the calcified beak, the membranous frontal area, and a mandibular cavity. (Fig. 13, *B*.) These are quite small and simple, without pivot or denticle, hardly distinct from the areolae.[1] Others, on the contrary, are highly perfected. (Fig. 13, *C*.) The glands mentioned by Waters have unknown functions.

*Interzooecial avicularia.*—There are ordinary zooecia deprived of polypide and containing only muscles. (Fig. 13, *E*.) Their variations are very important, for they express corresponding anatomical peculiarities. Their frontal is chitinous in the Malacostega (fig. 13, *F*), calcified in the Coilostega; in the latter case they constitute the *onychocellaria* (figs. 13, *G*, *H*) of Jullien, and in the group of the Tubifera they form the *reticulocellaria* of Canu (fig. 13 *I*). They are straight and symmetrical if the polypide of the adjacent zooecium has its large retractor muscle placed at the middle of the base (fig. 13, *H*); they are unsymmetrical if the same muscle is attached laterally, as in the genus *Onychocella* (fig. 13, *G*). In the Ascophora the interzooecial avicularia occur chiefly in the family Adeonidae. Nevertheless it is not rare to find some zooecia provided with a mandible (*Porella planulata*, new species, *Metroperiella grandipora*, new species, etc.). (Fig. 13, *J*.)

*Vibracula.*—The vibracula are heterozooecia formed of a cavity with chitinous or calcareous walls and of a long cilium or seta. Their organization is identical with that of the avicularia; they differ only in the articulation of the seta (=whip or flagellum) and in the great length of the latter.

"The base of the asymmetrical seta of the vibracula is very complicated with a large number of curiously shaped protuberances, to some of which the muscles

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[1] On the fossils it is often impossible to say if an observed small pore is a tremopore, an avicularium, a vibraculum, or a radicular pore.

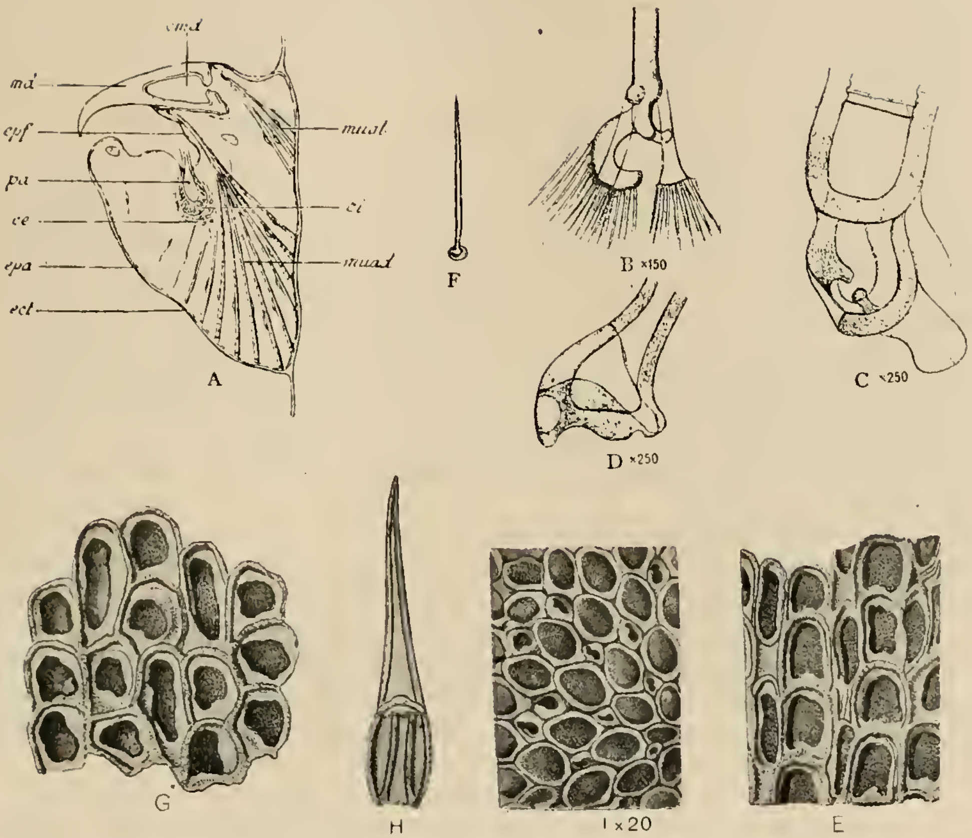

FIG. 14.—Structure of the vibraculum.

A. Longitudinal section of a vibraculum of *Cabcrea boryi* Audouin, 1826. (After Calvet, 1900.)

*ce*, external layer of the polypidian rudiment.
*ci*, internal layer.
*cmd*, cavity of the vibraculoid mandible (=seta).
*ect*, ectocyst.
*epa*, vibracularian epidermis.
*cpf*, facial epidermis.
*md*, vibraculoid mandible or seta.
*muab*, mandibular abductor muscle.
*muad*, mandibular adductor muscle.
*pa*, polypidian rudiment (=abortive polypide=ciliated organ=peculiar body).

B. Base of vibraculum of *Cribrilina latimarginata* Busk, 1884, × 150.

C. Lower part of vibraculum of *Selenaria maculata* Busk, 1852, × 250.

D. Base of vibraculum of *Cupuladria canariensis* Busk, 1852, × 250. (*B–D*, after Waters, 1888.)

E, F. Vibracula and seta of *Lunulites patelliformis* Maplestone, 1904.

G, H. Vibracula and seta of *Lunulites repandus* Maplestone, 1904. (*E–H*, after Maplestone.)

I. Auriculated vibracula of *Vibracellina capillaria* Canu and Bassler, 1917, × 20.

are attached fascia, but without any long tendon; they are more attached by a short band to various parts of the base of the seta. The vibracular base is very small, so that it is difficult to follow the complicated mechanism; the reason for this complication is found in the seta being movable in all directions. Very minute glands occur." (Waters, 1913.)

There are two sorts of interzooecial vibracula, the symmetrical and the non-symmetrical or auriculated (Fig. 14).

*Mucro.*—The mucro is a skeletal appendix, more or less salient and placed before the apertura. Its function is not yet clearly known. It is elongated in the more protected parts of the zoarium, just as the avicularia are. Moreover it appears to have the same use. Calvet in 1902 had already mentioned that in *Schizoporella ambita* Waters, 1902, and in *Emballotheca subimmersa*, MacGillivray, the suboral avicularium, is sometimes wanting and is replaced more often by a mucro becoming confused with the calcareous thickenings which surround the inferior border of the zooecial orifice in the somewhat aged bryozooids. We have noticed the same thing in *Metradolium labratulum*, new species. In the Cellopores the mucro of the deep zooecia, like the avicularia, sometimes projects to the level of the uppermost zooecia.

*Spines.*—The function of the spines is still not yet known. They become elongated in the protected parts of the zoarium. They do not exist on species provided with a long peristomie.

*Radicular fibers.*—The radicular fibers attach the zoaria to submarine objects. They leave only small perforations on the zooecia or on the avicularia in most of the articulated species. On the turbinated zoaria, in the Lunulites form of growth, they emerge from special, small zooecia without polypide perforated by a single pore.

### ZOOECIA.

*Form and size.*—The internal form of the zooecium is evidently in rapport with the reciprocal arrangement of all the soft parts in the interior. Unfortunately no zoological study has been made along this line which may be fruitful from the viewpoint of classification.

The external form is still more variable because of the intensity of calcification. It is in evident rapport with the surrounding medium and shows characters of adaptation. The influence of the medium on the zooecial form has never been the object of any zoological work.

"More generally the length of the tentacles is in rapport with that of the zooecia. In *Aetea anguina*, *Eucratea lafontii*, *Bugularia*, *Cellaria fistulosa*, *Cellaria salicornoides*, *Flustra securifrons*, *Microporella heckeli*, *Flustrella hispida*, *Pherusia tubulosa*, *Cylindroecium dilatum* and all the cyclostomes in which the zooecia are at least two times longer than wide, the tentacles are themselves long and often exceed half the length of the bryozooid. This rule is nevertheless not absolute and allows rather numerous exceptions. In *Bowerbankia pustulosa*, *Vesicularia spinosa*, *Amathia lendigera*, and *A. semiconvoluta*, for example, in which the zooecial cells are relatively very elongate, the tentacles are short and never exceed a third of the length of the bryozooid. Finally they are of a medium length in other species and have about two-fifths of the length of the bryozooid. The dimensions in thickness are also quite variable. Yet it seems that they are proportional to the dimensions of the general cavity and inversely to the number of the tentacles." (Translated from Calvet, 1900.)[1]

We give for each species the exterior micrometric dimensions of the zooecia; our measurements only express the average or the most frequent measurements. We are not able to draw up any general law. Very frequently the length is double the width; the other relations are more rare. There must be some very interesting studies to be made along this line, but we have not had the time to do so, and, moreover, a zoological basis is wanting absolutely.

*Total regeneration.*—The regeneration of the polypide is a phenomenon well known in bryozoology; it leaves no trace in the Cheilostomata. Sometimes, for causes unknown, it is the entire individual which is regenerated. This total regeneration leaves some external traces. It was thoroughly studied by Levinsen in 1907,[2] and he cited numerous examples. In the course of our work we have noted some interesting observations which confirm those of Levinsen. Following are some of the cases:

1. Replacement of a zooecium by an avicularium.
    *Hincksina megavicularia*, new species (pl. 23, fig. 1).
    *Lacerna hexagonalis*, new species (pl. 44, fig. 20).
2. Female polypide succeeding a male polypide.
    *Hincksina elegans*, new species (pl. 80, fig. 15).
3. Female zooecium inverted and succeeding a male polypide.
    *Membraniporidra laticella*, new species (pl. 26, fig. 5).
4. Replacement of a zooecium by a zooecium.
    *Floridinella vicksburgica*, Canu and Bassler (pl. 82, fig. 26).
5. Replacement of an ordinary zooecium by an inverted zooecium.
    *Membraniporidra laticella*, new species (pl. 26, fig. 4).
6. Replacement of a normal zooecium by a calcified zooecium.
    *Euritina tecta*, new species (pl. 5, fig. 2).
    *Velumella plicata*, new species (pl. 34, fig. 4).
7. Replacement of an avicularian zooecium by another avicularian zooecium.
    *Schizomavella granulosa*, new species (pl. 46, fig. 15).
8. Triple regeneration.
    *Grammella crassimarginata* Hincks (pl. 24, fig. 13).
    *Aldcrina crassa*, new species (pl. 29, fig. 7).

The effecting cause of total regeneration is unknown.

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[1] Contributions a l'historie naturelle des Bryozoaires ectoproctes marins. Travaux d'Institut de Zoologie de l'Université de Montpelier, Memoire No. 8, p. 183.

[2] 1907. Levinsen, Sur la régénération totale des Bryozoaires, Bulletin Academie Royal des sciences et des lettres de Danemark, pp. 151–160.

*Calcified zooecia.*—Calcification of the frontal in the Anasca and of the apertura in the Ascophora is a phenomenon quite frequent and still inexplicable. It is produced by the death of the polypide by accident or disease. Generally the calcified lamella is perforated; rarely it remains entire; sometimes it disappears under the tremopores.

We have mentioned the calcified zooecia each time that we have observed them, but for want of material we have not been able to make a detailed study. Following are some examples:

*Ramphonotus laevis*, new species (pl. 1, fig. 14).
*Rectonychocella bilamellaria*, new species (pl. 33, fig. 3).
*Floridinella vicksburgica* Canu and Bassler, 1917 (pl. 82, fig. 26).
*Metroperiella biplanata*, new species (pl. 47, fig. 15).
*Metroperiella porosa*, new species (pl. 47, fig. 8).
*Smittina exigua*, new species (pl. 59, fig. 17).
*Smittina angulata* Reuss (pl. 60, fig. 8).
*Cyclicopora spongiopsis* De Gregorio (pl. 88, fig. 10).
*Porella irregularis*, new species (pl. 62, fig. 20).
*Porella abdita*, new species (pl. 65, fig. 3).
*Porella portentosa*, new species (pl. 64, fig. 17).
*Adeonidae*, *Hippopodinidae.*

*Vestibular arch.*—The superior portion of the tentacular sheath is called the vestibulum. The latter is calcified sometimes in the vicinity of the anter of the apertura; this calcified lamella is the *vestibular arch.* It is very delicate and is little resistant in fossilization. We have rarely found it on our American specimens. (Figs. 15, *C*, *D*.)

## ZOARIUM.

*Terminology.*—For a given species, the form of the zoarium is almost always identical; nevertheless it is not rare to find some species both incrusting and free, the latter form of growth being only an advanced phase of the former. Some of the genera of bryozoa, now entirely archaic, were based on growth forms alone, and their names we now preserve in the literature simply in describing the form of zoaria. Among such names are the following:

*Eschara* refers to any free form of Ascophora with two lamellae back to back.

*Lunulites* comprise all the free turbinate, conical forms.

*Lepralia* is an incrusting form.

*Biflustra* has reference to a free form of the Anasca with two lamellae back to back.

*Vincularia* has rod-like zoaria.

*Celleporaria* is a creeping form of the Anasca.

*Cellepora* is any bryozoan made up of cumulate zooecia.

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[1] 1913. Larger (René), La contre-évolution ou dégénérescence par l'hérédité pathologique cause naturelle de l'extinction des groupes animaux actuels et fossiles. Essai de paléopathologie générale comparée, Paris.

We have avoided the use of these archaic terms in our descriptions save Eschara, Lunulites, and Vincularia.

The causes of zoarial variations are unknown.

The free zoaria very seldom remain intact in fossilization and we most always find them in the state of minute fragments. When the latter are very numerous it is always interesting to attempt their restoration. Those which we have made belong to species branching in a single plane and were relatively easy. We yet do not know how to restore the bushy zoaria.

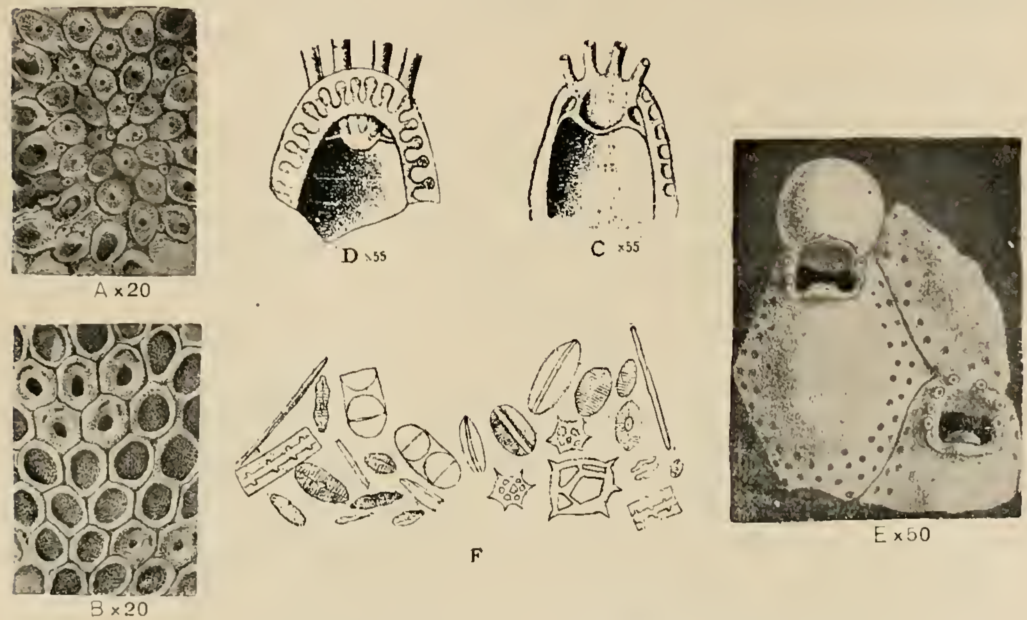

FIG. 15.—Structure of the vestibular arch, etc.

A. *Membrendoecium rectum*, new species. × 20. Calcified zooecia.

B. *Hincksina vicksburgica*, new species. × 20. Opesium not completely covered by calcification.

C, D. *Harmeria diaphana* MacGillivray, 1879. *C*. The distal half of a zooecium, the frontal wall of which has been removed, so that the highly developed vestibular arch may be seen and the rods by which it is connected with the lateral walls, × 55. *D*. The distal half of a zooecium, seen from the basal surface after removal of the basal wall. The basal wall of the vestibular arch is seen, × 55. (After Levinsen, 1909.)

E. Vestibular arch of *Mucronella peachi* Johnston, 1847, × 50. (After Busk, 1854.)

F. Diatoms and radiolaria found in the digestive apparatus of *Chaperia spinosa* Quoy and Gaimard, 1824. (After Jullien, 1888.)

*Habitat*.—The bryozoa live—first, in deep water; second, in waters always clear and limpid; and, third, in waters constantly agitated superficially by tempests and deeply stirred by currents. (D'Orbigny, 1850.)

The bryozoa are reduced for food to planktonic organisms; it is probable that they thrive particularly in places where a brisk current exists. The straits and narrow passages are ordinarily rich in bryozoa. (Nordgaard, 1912.) They feed upon diatoms and radiolaria (fig. 15, *F*).

The moving sands with large siliceous elements are not favorable for the habitat of bryozoa and there one can scarcely encounter a single example. The rocky facies, on the contrary, lend themselves very well to the establishment of colonies of bryozoa which swarm there. The muddy bottoms are very poor in bryozoa (Guerin-Ganivet, 1912).

The bryozoa are rather numerous in the shell sands. They are numerous in the zone of the mud sands with microcosms (25–60 meters); the shells serve as substratum to the numerous incrusting bryozoa, whereas the erect bryozoa more generally spread over the tunic of ascidians (Calvet, 1902).

The zoarial articulation is in rapport with the mobility of the habitat and with the zooecial fragility which requires some protection. All articulated species are then commensals of the great marine meadows.

## PRINCIPLES OF CLASSIFICATION OF THE CHEILOSTOMATA.

The principles of classification of this order are still imperfect in spite of the quite extended research of several students. Formerly the classification was based on purely zoarial features, but in the latter half of the nineteenth century the zooecial characters were more closely studied, especially by D'Orbigny, Smitt, and Hincks. The latter author considered especially the form of the aperture, in other words, only the hydrostatic system. In 1888, and again in 1903, Jullien established the systematic set of characters for consideration. These are as follows in diminishing order of importance:

Essential characters; general morphology (order); form of the frontal wall (sub-order); form of the aperture and of the operculum (family); presence of cardelles, occurrence of lyrula, and finally ovicells and radicels.

Secondary characters or specific; frontal punctations, avicularia, and vibracula.

In 1900 Canu wrote that every family ought to be based on an anatomical peculiarity common to all its members and fixed in an uninterrupted series of descendence. He established genera according to the variations of this anatomical peculiarity and according to the divergence of its evolutionary characters. This was the perfection of the ideas of Jullien, but the partial application made by Waters on the opercula and the avicularian mandibles did not appear always to lead to universal results nor to the establishment of very natural genera.

We now believe that other principles are better. In the bryozoa, as in other living beings, the form is only the result of functions; therefore in the study of the morphological variations of the organs we now substitute that of their physiologic functions. Our studies are therefore always directed toward the discovery of functions which modify the skeletal form.

[illegible](?)

*Family.*—All the species which have the same larval form have the same lineage and belong to the same family; therefore the family is characterized by its larval system. The ovicell in which the larva develops is necessarily in rapport with it, and a knowledge of its structure gives the essential characters for readily interpreting the physiological utility of the morphological and skeletal variations.

*Genus.*—A really natural genus differs from another genus only in possessing a different function and not in the different form of any skeletal part. The essential functions common to all bryozoa without exception are:

1. Passage of eggs and escapement of the larvae (=rapport of the operculum and the ovicell).

2. Hydrostatic system and extrusion of the polypide (=form of the aperture and rapport of the operculum with the compensatrix).

3. Calcification and chitinization (= nature of the skeletal part and of the frontal considered as immediate deposits of the endocyst).

All of these functions are indispensable. We combine them in such a way that all the species of a genus have the same essential functions.

We have rigorously followed this principle in the establishment of our new genera; we have also modified the descriptions of the described natural genera which were often incomplete.

Evidently often the form indicates the function; for example, the form of the aperture reveals the hydrostatic function, the presence of the cardelles indicates the movements of the operculum, the presence of a lyrula indicates the nature of the operculum, etc. But there are some morphologic variations without generic importance which may be common to numerous species; for example, nature, form, and attachment of the costules, granulations, and pleurocystal pores, form of the zooecium, presence of a rhamma, angle of divergence of zooecia, etc. These are the characters of adaption and are not the immediate result of essential functions.

A genus containing species combined only by the identity of characters of adaptation is not a natural one.

The function of the avicularia and onychocellaria is not known, but it can not be common to all bryozoa since many species are deprived of these structures; they therefore can not furnish good generic characters. Nevertheless, there are some groups in which their presence appears to be absolutely indispensable to the life of the zoarium and we have therefore considered them sometimes in our generic diagnoses. We are not certain that we are in the right path, but in the actual state of nomenclature such hesitation is permissible; moreover, the number of the genera to be suppressed is not considerable if in the future we should not be justified.

*Species.*—All the morphological variations and all of the characters of adaption are specific characters. They are always utilized without method because we are ignorant of the life of bryozoa.

## SYSTEMATIC CLASSIFICATION OF EARLY TERTIARY CHEILOSTOMATA.

We have inserted the following table showing the classification of the bryozoa here described in order to have a graphic aid in comprehending their position:

Class Bryozoa—Order Cheilostomata.

- Suborder Anasca (Compensation sac wanting.)
  - Division Malacostega
    - Electrinidae D'Orbigny, 1851.
    - Membraniporae Canu and Bassler, 1917.
    - Acteidae Smitt, 1867.
    - Scrupocellariidae Levinsen, 1909.
    - Farciminaridae Busk, 1852.
    - Eucratiidae Hincks, 1880.
    - Chaperiidae Jullien, 1888.
  - Division Coilostega
    - Opesiulidae Jullien, 1888 (Subfamilies Onychocellidae, Microporidae, and Lunularidae).
    - Steganoporellidae Levinsen, 1909.
    - Thalamoporellidae Levinsen, 1909.
  - Division Pseudostega
    - Membranicellariidae Levinsen, 1909.
    - Cellariidae Hincks, 1880.
    - Coscinopleuridae Canu, 1913.
- Suborder Ascophora (Compensation sac present.)
  - Costulae.
  - Acroporidae Canu, 1913.
  - Hippothoidae Levinsen, 1909.
  - Escharellidae Levinsen, 1909 (Groups Schizoporellae, Hippoporae, Peristomellae, and Microporellae).
  - Stomachetosellidae Canu and Bassler, 1917.
  - Smittinidae Levinsen, 1909.
  - Reteporidae Imperato, 1859.
  - Galeopsidae Jullien, 1903.
  - Hippopodinidae Levinsen, 1909.
  - Tubucellariidae Busk, 1884.
  - Catenicellidae Busk, 1852.
  - Adeonidae Jullien, 1903
  - Phylactellidae Canu and Bassler, 1917.
  - Celleporidae Busk, 1852.
  - Conescharellinidae Levinsen, 1909.

SYSTEMATIC DESCRIPTIONS.

# Order CHEILOSTOMATA Busk.

## Suborder ANASCA Levinsen.

A zooecial hydrostatic system is absent, but a zoarial hydrostatic system is present, and is included between the cryptocyst and the ectocyst.

The Anasca are classified under the three divisions Malacostega, Coilostega, and Pseudostega.

### Division I. MALACOSTEGA Levinsen, 1909.

The parietal muscles are attached to the cryptocyst, which is always chitinous. The operculum is a membranous valve (fig. 16). In the fossil forms the frontal wall is quite or partially uncalicified.

The families of this division are as follows, those in the first column being represented in this work:

Electrinidae D'Orbigny, 1851.
Membraniporae Canu and Bassler, 1917.
Aeteidae Smitt, 1867.
Scrupocellariidae Levinsen, 1909.
Farciminariidae Busk, 1884.
Eucratiidae Hincks, 1880.
Bicellariidæ Smitt, 1867.
Flustridae Smitt, 1867.
Notamiidae Hincks, 1880.

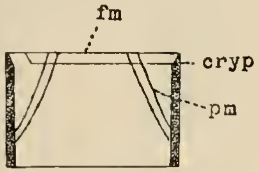

Fig. 16.—Sketch illustrating structure of the Malacostega.

Transverse section of a zooecium of a Flustrine form, showing the membranous ectocyst (*fm*, frontal membrane), the membranous cryptocyst (*cryp*), and the parietal muscles (*p. m.*). (After Harmer, 1902.)

### Family ELECTRINIDAE D'Orbigny, 1851.

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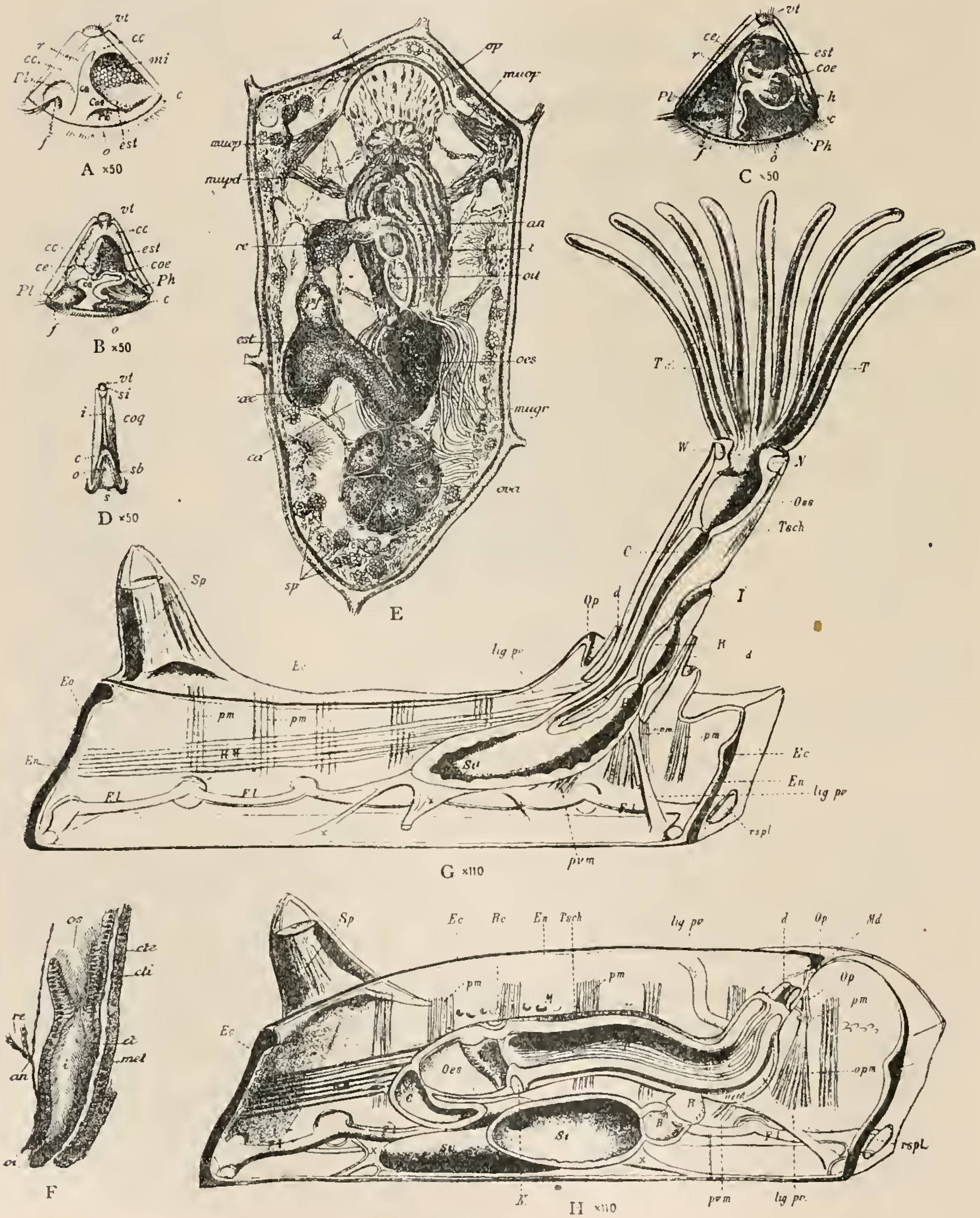
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Fig. 17.—Family Electrinidae D'Orbigny, 1851.

FIG. 17.—Family Electrinidae D'Orbigny, 1851.

A–F. *Electra pilosa* Linnaeus, 1758. (Larval form=*Cyphonautes compressus* Ehrenberg, 1833.)

A, B. Lateral views of larva, × 50, immediately after occlusion.
C. Larva, × 50, a little before fixation.
D. View from front, × 50. (A–D, After Barrois, 1877.)

*c*, corona.
*cc*, cavity of segmentation.
*cc*, cavity of the stomach.
*coe*, lateral diverticulum of the stomach cavity.
*coq*, shell.
*cst*, stomach.
*f*, fossette of the plume.
*h*, portion charged with elements (hepatic?) under the enigmatic organ of Schneider.
*mi*, aboral mass.
*o*, mouth of the gastrula.
*Ph*, pharynx.
*Pl*, ciliary plume.
*r*, large retractor muscles.
*s*, oral face.
*si*, separating furrow of the terminal bud.
*ct*, terminal bud.

E. Sketch showing anatomy of polypide. (After Calvet, 1900.)

*an*, anus.
*ca*, cardia.
*caec*, caecum.
*d*, vaginal diaphragm.
*est*, stomach.
*muop*, opercular muscles.
*mugr*, large retractor muscles of the polypide (or of the lophophore).
*mupd*, parietal or expulsor muscles of the polypide.
*oes*, oesophagus.
*oit*, intertentacular organ.
*op*, operculum.
*ova*, ovary.
*py*, pylorus.
*re*, rectum.
*sp*, spermatoblast morulae.

F. Longitudinal section of the intertentacular organ. (After Calvet, 1900.)

*ct*, tentacular canal.
*ete*, external tentacular epithelium.
*eti*, internal tentacular epithelium.
*i*, inferior cavity.
*met*, anhistous membrane of the tentacles.
*oi*, superior orifice.
*os*, superior cavity.
*rc*, rectum.

G, H. *Membranipora membranacea* Linnaeus, 1758.
Two drawings exhibiting the anatomy of the polypide, × 100. (After Nitsche, 1871.)

*c*, cardial part of the stomach.
*d*, interior diaphragm of the tentacular sheath.
*ec*, ectocyst.
*en*, endocyst.
*oes*, esophagus.
*op*, fold of the opercular valve.
*opm*, muscles of the operculum.
*P*, pyloric part of the stomach.
*pm*, parietal or extensor muscles of the polypide.
*R*, rectum.
*RM*, retractor muscles of the lophophore (or of the polypide).
*rspl*, septula.
*st*, stomach.
*T*, tentacles.
*tsch*, tentacular sheath.
*x*, mesenchyme.

Zooecia having a chitinous frontal. Intertentacular organ present. Larva a Cyphonautes. No avicularia. No dietellae. Operculum with thickened border.

*Historical.*—The family Electrinidae was established in 1851 by D'Orbigny for species possessing "cellules en cornet," and was based on the genus *Electra* Lamouroux, 1816. Two genera, *Canda* and *Caberea*, which D'Orbigny included in the family at that time, had to be withdrawn, because they did not have the same larval features. The *Electra pilosa* group has been the subject of numerous anatomical studies.

The *Membranacea* group is also a natural division, and it is considered as containing typical *Membranipora*, which is the basis of the family Membraniporidae Smitt, 1866. The intertentacular organ is known here also. In 1906 Miss Robertson discovered the Cyphonautes larva in *Membranipora villosa*, which therefore belongs to the same group.

*Electra* and *Membranipora*, having similar larval forms, belong to the same family, Electrinidae. This name, given by D'Orbigny, has the right of priority.

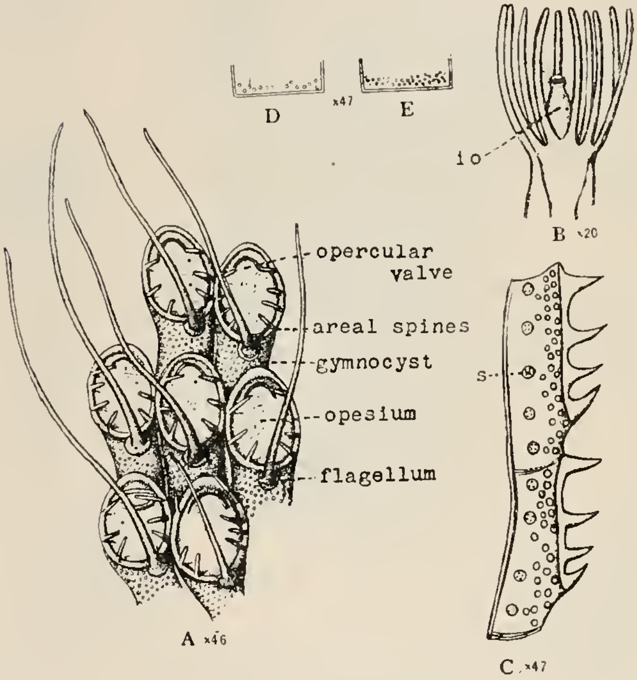

FIG. 18.—Genus *Electra* Lamouroux, 1816.

A–E. *Electra pilosa* Linnaeus, 1758. A. Several zooecia, × 46, illustrating structure. (After Hincks, 1880.) B. Drawing showing intertentacular organ (*i. o.*), × 20. C. Lateral wall, exhibiting multiporous septulae (*s*), × 47. D, E. Uniporous septulae of the distal wall, × 47. (B–E, after Levinsen, 1894.)

*Classification.*—The known genera of the Electrinidae are as follows:

*Electra* Lamouroux, 1816.
*Membranipora* Blainville, 1834.
*Heterooecium* Hincks, 1892.
*Pyripora* D'Orbigny, 1852.
*Herpetopora* Lang, 1914.

The two latter genera have been placed in the family on account of zooecial resemblance, and not from a study of their anatomy.

### Genus ELECTRA Lamouroux, 1816.

1816. *Electra* LAMOUROUX, Histoire des Polypiers Coralligenes flexibles, p. 121.

The frontal is a gymnocyst. There is a circle of spines around the frontal area. The distal septulae are uniporous. The lateral walls have 2 or 3 multiporous septulae.

*Genotype.*—*Electra pilosa* Linnaeus, 1758. *Range.*—Eocene-Recent.

The recent species belonging to this genus are according to Levinsen and Waters:

*Electra* (*Flustra*) *pilosa* Linnaeus, 1758.
*Electra verticellata* Lamouroux, 1816.
*Electra* (*Membranipora*) *bellula*, Hincks, 1880.
*Electra* (*Flustra*) *triacantha* Lamouroux, 1816.
*Electra* (*Membranipora*) *distorta* Hincks, 1880.
*Electra* (*Tendra*) *zostericola* Nordman, 1839.
*Electra* (*Membranipora*) *monostachys* Busk, 1852.
*Electra* (*Membranipora*) *bicolor* Hincks, 1880.
*Electra* (*Membranipora*) *tenella* Hincks, 1880.

### ELECTRA PARVIMATER, new species.

Plate 19, figs. 1–3.

*Description.*—The zoarium incrusts oysters; it is uniserial around the ancestrula, but later it develops into multiserial branches. The zooecia are elongated, distinct, pyriform; the gymnocyst is smooth and convex; the mural rim is enlarged at the base, flat, and finely striated. The opesium is large, oval, very finely crenulated. The ancestrula is very small.

*Measurements.*—Opesium $\left\{\begin{array}{l} ho=0.28\text{ mm.} \\ lo=0.15\text{ mm.}\end{array}\right.$[1] Zooecium $\left\{\begin{array}{l} Lz=0.40\text{ mm.} \\ lz=0.24\text{ mm.}\end{array}\right.$

*Affinities.*—This species belongs to the group of *Electra monostachys* Busk, 1852. It differs from Busk's species in its smaller micrometric dimensions and in the oval form of the zooecia. Moreover the extreme smallness of the ancestrular zooecia has not been noted in this latter species.

*Occurrence.*—Lower Jacksonian (Moodys marl): 2½ miles north of Robert, Newton County, Mississippi (rare).

*Holotype.*—Cat. No. 65865, U.S.N.M.

### Genus MEMBRANIPORA Blainville, 1834.

1834, *Membranipora* BLAINVILLE, Manuel d'Actinologie ou de Zoophytologie, p. 447.

No gymnocyst on the frontal. Two spines at least.

*Genotype.*—*Membranipora membranacea* Linnaeus, 1758. Miocene–Recent.

The living species belonging to this genus are, according to Waters:

*Membranipora membranacea* Linnaeus, 1758.
*Membranipora danica* Levinsen, 1894.
*Membranipora* (*Flustra*) *tuberculata* Bosc, 1802.
*Membranipora* (*Flustra*) *inca* D'Orbigny, 1839.

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[1] In the citation of measurements, *ho* is the length and *lo* the width of the opesia, *Lz* and *lz* similarly the length and width of the zooecia, *Lv* and *lv* the same for vibraculum, *Lon* and *lon* for the onychocellaria, *ha* and *la* for the apertura, etc.

*Membranipora villosa* Hincks, 1880.
*Membranipora* (*Flustra*) *isabelleana* D'Orbigny, 1839.
*Membranipora pura* Hincks, 1880.
*Membranipora* (*Flustra*) *tehuelcha* D'Orbigny, 1839.
*Membranipora nitens* Hincks, 1880.
*Membranipora hyadesi* Jullien, 1888.

### Genus HETEROOECIUM Hincks, 1892.

1892. *Heterooecium* HINCKS, Contributions towards a General History of the Marine Polyzoa, Appendix, Annals and Magazine Natural History, ser. 6, vol. 9, p. 312.

The ovicell is acanthostegous.

*Genotype.—Heterooecium amplectens* Hincks. 1881. Recent.

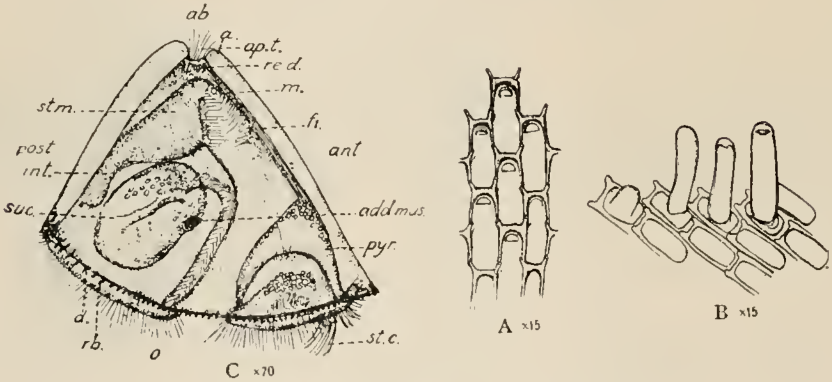

FIG. 19.—Genus *Membranipora* Blainville, 1834.

A, B. *Membranipora membranacea* Linnaeus, 1758. A. Ordinary zooecia, × 15. B. Abnormal cells ("tower zooecia"), × 15. (After Hincks, 1880.)

*C. Cyphonautes occidentalis* Robertson, 1908, the larval stage of *Membranipora villosa* Hincks, 1880, × 70, showing the organism in optical section as it appears while still living and lying on its side. *a*, apex; *ab*, aboral; *add. mus.*, adductor muscle; *ant*, anterior; *ap. t*, apical tuft; *d*, denticle; *fi*, fiber; *int*, intestinal tract; *m*, mouth; *O*, oral; *post*, posterior; *pyr*, pyriform body; *rb*, rib; *re. d*, retractile disk; *st. c*, stiff cilia; *stm*, stomach; *suc*, sucker.

### Genus PYRIPORA D'Orbigny, 1852.

1852. *Pyripora* D'ORBIGNY, Paleontologie francaise, Terrain Crétacé, Bryozoaires, vol. 5, p. 538.

Colony fixed, creeping over the surface of other bodies, formed of little regular, longitudinal and lateral lines of cells placed one after the other, not contiguous laterally, and disposed in a manner to represent creeping branches more or less extended. Cellules pyriform, narrow behind, and enlarged in front, open in dead or fossil individuals over the greater part of their anterior portion. No special pores, no accessory cells, nor ovarian vesicles. (After D'Orbigny, 1852.) The operculum is calcified. (Levinsen, 1909.)

*Genotype.—Membranipora catenularia*, Jameson, 1814.

*Range.*—Cretaceous-Recent.

The French author added that in creating the genus *Pyripora* in the Prodrome of Stratigraphie Paleontology he had placed there all species with colonies formed of isolated cells, but that now in the restriction of families it was necessary to give more special characters, and that therefore he would restrict *Pyripora* solely to species with large open cells without special pores.

*History and discussion.*—In 1847, when D'Orbigny published his Prodrome, it was the author's idea that this was only a provisional work which later researches would modify. D'Orbigny's supplementary work classifying both fossil and recent bryozoa was published in the Paleontologie Française of 1850 to 1852. This superseded the Prodrome, and of course is alone to be considered. In this special case, priority has no significance and can not be invoked for the date of a genus or species.

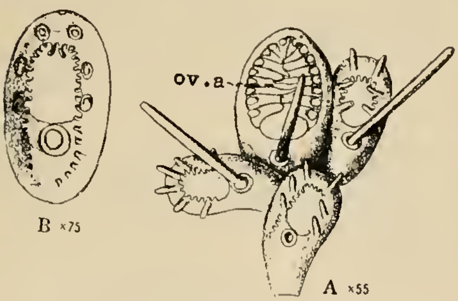

Fig. 20.—Genus *Heterooecium* Hincks, 1892.

A, B. *Heterooecium amplectens* Hincks, 1892. A. Several zooecia, × 55. The small denticles are not only seen at the margin of the membranous area but are also visible through the calcified wall of the frontal surface. The acanthostegous ovicell (*ov. a.*) has its cavity between the spines and the ectocyst. B. The frontal wall of a zooecium, × 75, seen from the internal surface. (After Levinsen, 1909.)

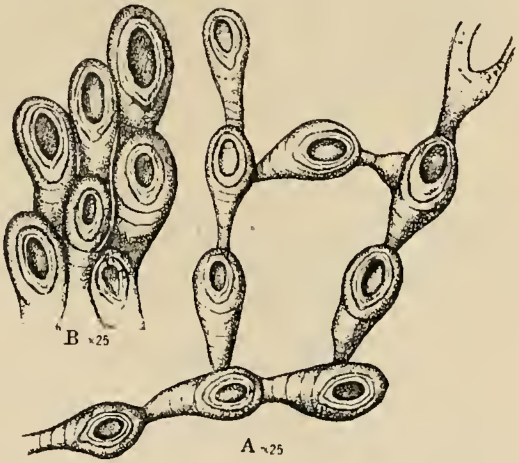

Fig. 21.—Genus *Pyripora* D'Orbigny, 1852.

A, B. *Pyripora catenularia* Jameson, 1814. A. Linear form, × 25, with regenerated zooecia. B. Expansion of zooecia, × 25, with all of them regenerated. (After Hincks, 1880.)

Similarly, MacGillivray has given many definitions of his genus *Hiantopora*, and it becomes a question which one of them is to be recognized. Logically it should be the last one which is the result of the most detailed and complete studies of the author.

In 1852 D'Orbigny cited four species of *Pyripora*—three fossil forms, *Escharina crenulata* Reuss, *Escharina perforata* Reuss, *Criserpia pyriformis* Michelin, and one recent, *Pyripora ramosa* D'Orbigny; but as he did not cite a type, the choice of one therefore becomes necessary. Common sense would indicate that his recent species, which has always been considered as synonymous with *Membrani-*

*pora catenularia* Jameson, should be selected. Waters,[1] however, decided that the two were distinct species, but undoubtedly of the same group. We can thus logically select *Membranipora catenularia* as a typical species of the genus *Pyripora* D'Orbigny, 1852. This species is not rare, and the studies which it will receive will complete the definition of the genus and delimit the family characters.

Mr. Lang was kind enough to write us that Bronn and Roemer in 1851 had chosen *Escharina crenulata* as the type of *Pyripora* D'Orbigny, 1847. We would say that this species does not conform to the very vague definition of 1847, and that as the definition of 1852 cancels that of 1847, the selection of Bronn and Roemer is therefore annulled.

Such an irrational application of the law of priority has led Gregory into a paradoxical error. His genus *Zonopora* D'Orbigny does not contain a single species that D'Orbigny himself had classed in it. From this one would infer that the celebrated French paleontologist did not know what he was writing about.

### PYRIPORA PARVICELLA, new species.

Plate 3, fig. 1.

*Description.*—The zoarium incrusts shells. The zooecia are arranged in isolated linear rows; they are *small*, quite elongated, pyriform, much narrowed in the rear; the gymnocyst is smooth and convex; the opesium is anterior, elliptical, very finely crenulated, with a length of a third of the zooecia.

*Measurements.*—Opesium $\begin{cases} ho=0.16 \text{ mm.} \\ lo=0.10 \text{ mm.} \end{cases}$ Zooecia $\begin{cases} Lz=0.45 \text{ mm.} \\ lz=0.20 \text{ mm.} \end{cases}$

*Affinities.*—This neat little species differs from *Pyripora tuberculum* Lonsdale, 1845, in its lesser zooecial length and in the more regular form of its zooecia. Several well-preserved specimens have been found.

*Occurrence.*—Midwayan (Clayton limestone): Brundidge, Alabama (rare).

*Holotype.*—Cat. No. 63787, U.S.N.M.

### PYRIPORA TUBERCULUM Lonsdale, 1845.

Plate 19, fig. 4.

1845. *Hippothoa tuberculum* LONSDALE, Account of twenty-six species of Polyparia obtained from the Eocene Tertiary formations of North America, Quarterly Journal Geological Society, London, vol. 1, p. 527.

1852. *Pyripora tuberculum* D'ORBIGNY, Prodrome paleontologie stratigraphique, vol. 2, p. 396.

1862. *Pyriflustrella tuberculum* GABB and HORN, Monograph of the fossil Polyzoa of the Secondary and Tertiary formations of North America, Journal Academy Natural Sciences, Philadelphia, ser. 2, vol. 5, p. 163.

*Description.*—The zooecia are rounded anteriorly and very much constricted posteriorly; the gymnocyst is convex, more or less striated transversely; the mural rim is broad, tuberculated, divided into two parts by a circular furrow; the opesium is slightly pyriform, the narrow end raised. The normal mode of branching is bilateral.

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[1] 1907. Waters, Notes on some recent bryozoa in D'Orbigny's collection, Annals and Magazine Natural History, ser. 7, vol. 15, p. 11.

*Measurements.*—Opesia $\left\{\begin{array}{l} ho=0.15 \text{ mm.} \\ lo=0.05\text{–}0.075 \text{ mm.} \end{array}\right.$ Zooecia $\left\{\begin{array}{l} Lz=0.60\text{–}0.70 \text{ mm.} \\ lz=0.25\text{–}0.30 \text{ mm.} \end{array}\right.$

Certain zooecia bear on the gymnocyst near the opesium a little pore that is perhaps the place of a spine. The olocyst appears to be formed of two calcareous superposed layers.

The micrometric dimensions of this species are identical with those of *Pyripora catenularia* Jameson, 1814, relying upon the figures given by Hincks, but the small tuberosities of the mural rim in *P. tuberculum* alone distinguish the two species. We have been unable to make direct comparison with this living species, and therefore can not pronounce on the identity of the two.

*Occurrence.*—Middle Jacksonian (Castle Hayne limestone): Wilmington, North Carolina (rare).

*Plesiotype.*—Cat. No. 63866, U.S.N.M.

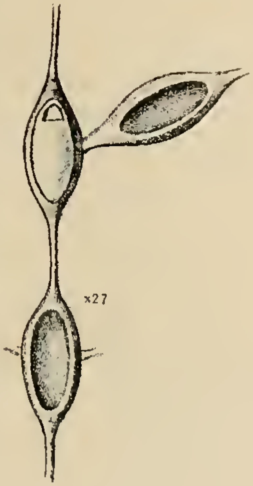


FIG. 22.—Genus *Herpetopora* Lang, 1914.

Several zooecia of *Herpetopora anglica* Lang, 1914, × 27, two of which are normal and the third sealed. (After Lang, 1914.) Cretaceous (Senonian): Chatham, England.

### Genus HERPETOPORA Lang, 1914.

1914. *Herpetopora* LANG, On Herpetopora, a new genus of Cretaceous Cheilostome Polyzoa, Geological Magazine, dec. 6, vol. 1, p. 7.

Incrusting, uniserial. The mode of branching is bilateral. Heteromorphic individuals may occur. The normal zooecia consist of a distal "capitular" and a proximal "caudal" portion. Sealed and reversed zooecia very common. (After Lang.)

*Genotype.*—*Herpetopora anglica* Lang, 1914.

*Range.*—Cretaceous-Vicksburgian.

This genus has been confused in part with *Pyripora* D'Orbigny, and even now we do not venture to affirm that the Cretaceous species figured by Lang are not the same group as *Pyripora catenularia*. It will be necessary to know the significance of the heteromorphic zooecia noted by the author before the full value of the genus can be determined. However, in case of identity with *Pyripora* in these respects, Lang's genus might still be maintained for the species devoid of the caudal portion.

#### HERPETOPORA DANICA Lang, 1914.

Plate 80, fig. 1.

1914. *Herpetopora danica* LANG, On Herpetopora, a new genus of Cretaceous Cheilostome Polyzoa, Geological Magazine, dec. 6, vol. 1, p. 7, pl. 11, figs. 6, 7.

Species of such elementary structure can hardly be distinguished from each other by any other means than their micrometric dimensions. Both the Cretaceous species *Herpetopora danica* and our specimens from the Vicksburgian have an opesium measuring 0.72–0.80 mm. by 0.40 mm. The Cretaceous specimens differ from those of the Vicksburgian in having the opesia finely crenulated. Moreover, some of our specimens branch unilaterally. However, these differences can be proved to exist in the same species. It should be noted that there is no basal olocyst in this species; the lateral walls alone of each zooecium are calcified.

*Occurrence.*—Vicksburgian ("Chimney rock" of Marianna limestone): One mile north of Monroeville, Alabama (rare).

*Geological distribution.*—Senonian of England; Danian of Denmark (Lang, 1914).

*Plesiotype.*—Cat. No. 64229, U.S.N.M.

## Group MEMBRANIPORAE Canu and Bassler, 1917.

1917. *Membraniporae* Canu and Bassler, Synopsis of American Early Tertiary Cheilostome Bryozoa, Bulletin 96, United States National Museum, p. 9.

*Bibliography (anatomical and classification).*—1898, Waters, Observations on Membraniporidae, Journal Linnean Society, London, Zoology, vol. 26, pp. 656, 691, pls. 47–49.—1900, Calvet, Contribution a l'historie naturelle des Bryozoaires ectoproctes marins, Travaux l'Institut de Zoologie de l'Université de Montpelier, Mem. No. 8, p. 262, pl. 10.—1900, Canu, Revision des Bryozoaires du crétacé figurés par D'Orbigny, Cheilostomata, Bulletin Géologique Société France, vol. 28, p. 353.—1903, Norman. Notes on the Natural History of East Finmark, Annals and Magazine of Natural History, ser. 7, vol. 11, p. 584.—1909, Levinsen, Morphological and Systematic Studies on the Cheilostomatous Bryozoa, p. 143.—1913, Waters, Marine Fauna of British East Africa and Zanzibar, Bryozoa, Cheilostomata, Proceedings Zoological Society, London, pl. 71, fig. 1.

This very large group is too heterogeneous to be considered as a single family: indeed it is certain that the genera classified here at present will ultimately be assigned to many families. Unfortunately we are ignorant of the larvae, and researches upon the anatomy of these forms have not been made.

The first attempt at classification was made by Waters in 1898 in his excellent work on the Membraniporidae. This author defined 14 groups which for the most part are absolutely natural and which should be considered as distinct genera. We have had frequent occasion to refer to this publication.

Canu's researches in 1900 were quite incomplete, as they were limited to the Cretaceous species in which most of the specimens were devoid of ovicells. This author then considered chiefly the interzooecial avicularia.

The work of Norman in 1903 is based for its most part upon the presence or absence of the dietellae and upon the number of septulae. This author established a number of natural genera.

The material upon which our present researches are founded is most abundant—but as it is impossible to establish a satisfactory nomenclature with fossils alone, we must be content to utilize the works of our predecessors. We have studied especially the ovicells and their relations to the opercular valve, for these are the organs in closest relation to the larval system. In the following table are listed the genera of Membraniporae with the possible family reference of some of them.

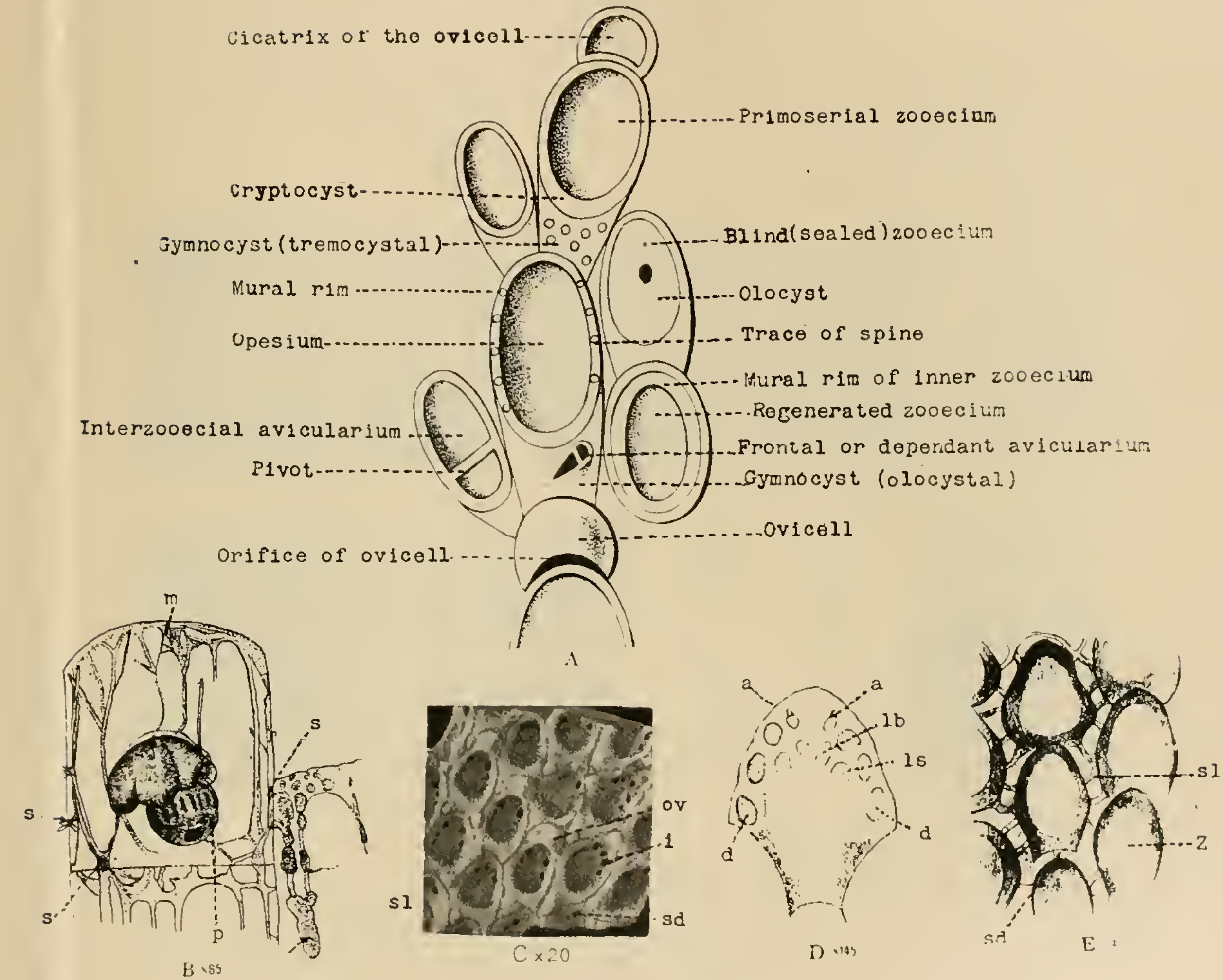

Cicatrix of the ovicell
Primoserial zooecium
Cryptocyst
Blind(sealed)zooecium
Gymnocyst(tremocystal)
Mural rim
Olocyst
Opesium
Trace of spine
Mural rim of inner zooecium
Regenerated zooecium
Interzooecial avicularium
Frontal or dependant avicularium
Pivot
Gymnocyst (olocystal)
Ovicell
Orifice of ovicell
A
m
s
s
s
p
B ×85
ov
i
sl
sd
C ×20
a
a
lb
ls
d
d
D ×145
sl
Z
sd
E

Fig. 23.—Structure of the Membraniporae.

A. Sketch showing terminology.

B. *Acanthodesia savartii* Audouin, 1826. Drawing showing structure. × 85. (After Waters, 1913.) *m*, mesenchymatous filaments; *p*, polypide in which histolysis has commenced; *s*, septula.

C. *Alderina nodulosa*, new species. View of zooecia, × 20. *i*, impression corresponding to lucid spot; *ov*, ovicell; *sd*, distal septula; *sl*, lateral septula.

D. *Antropora granulifera* Hincks, 1880. View of the back of a zooecium. × 145. (After Norman, 1903.) *a*, openings resulting from the avicularia; *d*, *lb*, lucid bay; *ls*, lucid spot.

E. *Membraniporina* (*Biflustra*) *flabellata* D'Orbigny, 1852. Cast of the interior, after decalcification, × 45. (After Beissel, 1865.) *sd*, distal septula; *sl*, lateral septula; *z*, zooecium.

The communication pores between the zooecia, here much enlarged, have the aspect of small canals. They serve as passage for the mesenchymatous fibers.

## GENERIC TABLE OF MEMBRANIPORAE.

### Section I. No ovicell.

| Genera represented. Family presumed. | Genera unrepresented. Family presumed. |
|---|---|
| *Conopeum* Norman, 1903. | *Discoflustrellaria* D'Orbigny, 1851. |
| *Membraniporina* Levinsen, 1909. | *Crepis* Jullien, 1882. |
| *Adenifera* Canu and Bassler, 1917. | *Heliodoma* Calvet, 1907. |
| *Cupuladria*, new genus. | |
| *Acanthodesia*, new genus. | |
| *Trochopora* D'Orbigny, 1852. | |
| *Otionella* Canu and Bassler, 1917. | |

### Section II. Ovicell endozooecial.

| | |
|---|---|
| *Hincksina* Norman, 1903, Flustridae (Norman). | *Setosellina* Calvet, 1907. |
| *Membrendoecium* Canu and Bassler, 1917. Farciminariidae. | |
| *Ogivalina* Canu and Bassler, 1917. Onychocellidae. | |
| *Vibracellina* Canu and Bassler, 1917, Lunulariidae. | |

### Section III. Ovicell hyperstomial, closed by the opercular valve.

| | |
|---|---|
| *Periporosella* Canu and Bassler, 1917, special family. | *Tremopora* Ortman, 1890, Bicellariidae (Levinsen). |
| *Ellisina* Norman, 1903. | *Larnacius* Norman, 1903, special family. |
| *Grammella* Canu, 1917. | |
| *Membraniporidra* Canu and Bassler, 1917. | |

### Section IV. Ovicell hyperstomial, not closed by the opercular valve.

| | |
|---|---|
| *Alderina* Norman, 1903. | *Ammatophora* Norman, 1903. |
| *Callopora* Gray, 1848. | *Marssonopora* Lang, 1914. |
| *Tegella* Levinsen, 1909. | |
| *Amphiblestrum* Gray, 1848. | |
| *Ramphonotus* Norman, 1894. | |
| *Stamenocella* Canu and Bassler, 1917. Bicellariidae. | |

### Section V. Miscellaneous.

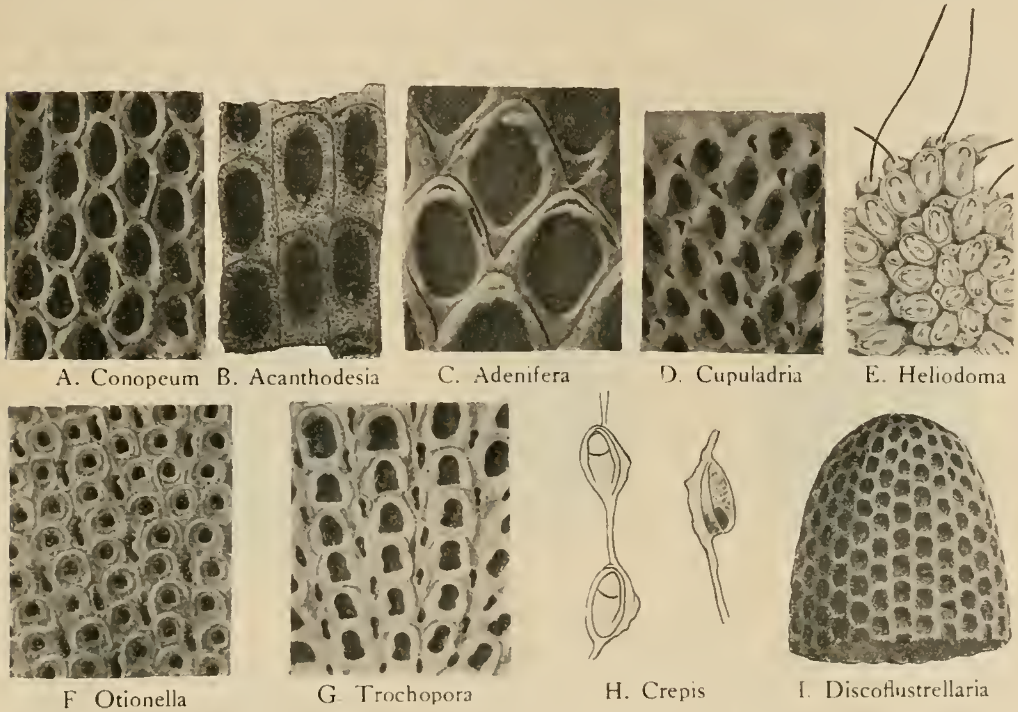
| | |
|---|---|
| *Cauloramphus* Norman, 1903. | *Foveolaria* Busk, 1883. |
| | *Membrostega* Jullien, 1903. |
| | *Antropora* Norman, 1903. |

The dorsal of some Membraniporae present certain thinning or thickening, as in *Antropora granulifera* Norman (fig. 23). This phenomenon manifests itself on the fossils by little cavities or impressions. We have found them in *Alderina nodulosa*, new species (fig. 23). Their physiological significance is unknown.

The dorsal of the Membraniporae also shows the dietellae visible by transparency. On well-preserved fossils they can be best revealed by abrading the surface slightly. Beissel employed a quite complex but very instructive method of casting in order to show these structures (fig. 23).

The septulae are rarely visible in fossil forms, although the multiporous septulae often leave a large communication pore.

In the study of the fossil bryozoa we have considered that the ovicell which leaves a trace above the mural rim is hyperstomial. When the ovicell projects much over the mural rim it is closed by the operculum under the opesium, but it always remains open when it does not project over the mural rim.


A. Conopeum B. Acanthodesia C. Adenifera D. Cupuladria E. Heliodoma

F Otionella G Trochopora H. Crepis I. Discoflustrellaria

FIG. 24.—Genera of Membraniporae without ovicell.

A. *Conopeum lacroixi* Busk, 1852. × 20. Claibornian, Claiborne, Alabama.

B. *Acanthodesia savartii* Audouin, 1826, × 25. Recent.

C. *Adenifera inarmata* Canu and Bassler, 1917. × 20. Middle Jacksonian, near Lenuds Ferry, South Carolina.

D. *Cupuladria canariensis* Busk, 1859, × 20. Lower Miocene of Costa Rica.

E. *Heliodoma implicata* Calvet, 1907. × 30. Recent.

F. *Otionella perforata* Canu and Bassler, 1917. × 20. Lower Jacksonian, Jackson, Mississippi.

G. *Trochopora bouei* Lea, 1833. × 20. Claibornian, Claiborne, Alabama.

H. *Crepis longipes* Jullien. × 20. Recent.

I. *Discoflustrellaria doma* D'Orbigny. Cretaceous (Senonian) of France.

An ovicell closed by the operculum is often immersed, making its distinction from the endozooecial a matter of great care.

## SECTION 1. MEMBRANIPORAE WITHOUT OVICELL.

### Genus CONOPEUM Norman, 1903.

1903. *Conopeum* NORMAN, Natural History of East Finmark, Annals Magazine Natural History, ser. 7, vol. 11, p. 586 (1848, Gray, List British Animals British Museum. Centroniae, pp. 108, 146).

No ovicell, no dietellae, no avicularia. The margins of the mural rim are wholly granulated. A distal, multiporous septula; two or three lateral septulae. Triangular, interopesial hollows having special walls.

*Genotype.*—*Membranipora lacroixii* Authors.

*Range.*—Cenomanian-Recent.

The granulations of the mural rim are often very fine and attenuated on the fossil forms. In these also the distal septulae often unite into a very large pore.

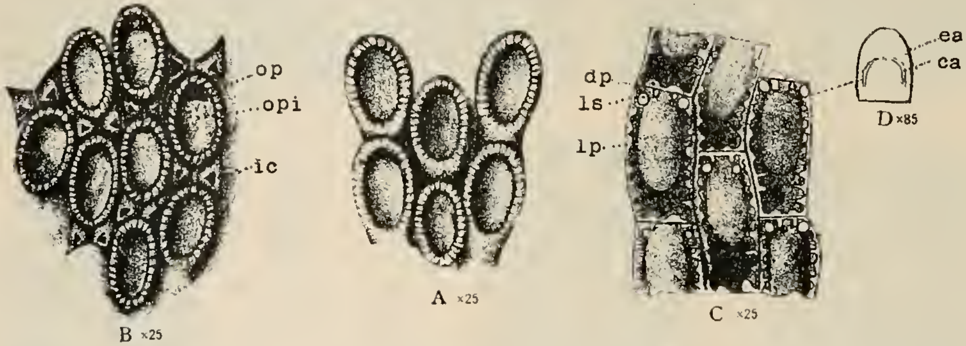


FIG. 25.—Genus *Conopeum* Norman, 1903.

A–D. *Conopeum lacroixii* Busk, 1852. A. Zooecia, × 25. B. Zooecia, × 25, with interopesial cavity (*i. c.*); operculum (*op*), and opesium (*opi*). C. Dorsal surface, × 25, showing a pair of transparent circles (*l. s.*=lucid spots of Norman), irregular projections (*lp*) on the lateral wall, and a pair of projections (*d. p.*) on the distal wall opposite those on the next zooecium. D. Operculum, × 85, with chitinous arch (*ca*) and membranous extension (*ea*). (A, B after Hincks, 1880, and C, D after Waters, 1898.)

The hollows of the surface are not interzooecial, as Levinsen has described them, but are only interopesial; they are not deep and are situated between the mural rims; rarely they contain an avicularium; their purpose is unknown. In living specimens Waters has described two lucid spots on the dorsal side. These are replaced on the fossils by two hollow impressions in the dorsal olocyst. We are ignorant of their use, for they have no connection with the operculum.

The type of this genus is very common on the coasts of France and England, and Osburn has noted its occurrence in American waters. However, no naturalist has made a study of its embryology and anatomy.

The known species of this genus, in addition to the genotype, are:

*Conopeum* (*Membranipora*) *bravardi* Canu, 1911, Rocanean of Argentina.
*Conopeum* (*Membranipora*) *arborea* Canu, 1911, Rocanean of Argentina.
*Conopeum* (*Membranipora*) *langana* Canu, 1911, Rocanean of Argentina.
*Conopeum* (*Membranipora*) *maplestonei* Canu, 1911, Rocanean of Argentina.

### CONOPEUM ORNATUM, new species.

Plate 3, fig. 2.

*Description.*—Zoarium bilaminate. The zooecia are distinct but separated by a common elevation. The mural rim is somewhat rounded and almost everywhere of equal breadth. The opesium is median and elliptical. The interopesial cavities are distinct and irregular.

*Affinities.*—The *ornamentation* of its surface renders this species absolutely characteristic, although this feature is reproduced sometimes in other species, but only accidentally. Unfortunately we possess but a single fragment of this interesting form.

*Occurrence.*—Midwayan (Clayton limestone): Mabelvale, near Little Rock, Arkansas (very rare).

*Holotype.*—Cat. No. 63788, U.S.N.M.

### CONOPEUM DAMICORNIS, new species.

Plate 3, figs. 3–8.

*Description.*—The zoarium is free, formed of two lamellae growing back to back, irregularly bifurcated; the fronds are distorted. The zooecia are distinct, irregular, polygonal, or elliptical; the mural rim is very thin, regular, projecting but little, convex. The opesium has the same form as the zooecium. The interopesial cavities are polygonal and of a very great irregularity.

*Measurements.*—Opesia $\left\{\begin{array}{l} ho=0.32 \text{ mm.} \\ lo=0.20 \text{ mm.} \end{array}\right.$ Zooecia $\left\{\begin{array}{l} Lz=0.35 \text{ mm.} \\ lz=0.23 \text{ mm.} \end{array}\right.$

*Variations and affinities.*—This species has zooecia of a disconcerting irregularity; it is absolutely impossible to discover among them a form the least constant. The same holds true with the interopesial cavities which disappear following the irregularities of the zoarium.

The structure of the zooecial walls is quite remarkable. In tangential sections (fig. 6) these walls appear normal but in transversal thin sections, they are thickened, crenulated on the inside, and composed of tissue not very dense (fig. 5). In the median thin sections obtained by rubbing away both sides of the fronds, a structure may be noted identical with the zooecial walls; the olocystal elements grouped around the mural rim appear to be chambered (fig. 7). Finally, a section taken perpendicularly to the plane of the fronds (fig. 8) shows that the zoarium is formed of two lamellae placed back to back and separable.

The false chambering of the mural rim is not analogous to the formation of dietellae in *Periporosella;* we find in reality in every species chambered in this way some large, scattered, unoriented olocystal elements (figs. 4, 6).

The zoarium itself is quite constant and characteristic; it often assumes, although rather vaguely, among other shapes, the form of the *horns of a deer*, hence our specific name. As its zoarial dimensions exceed two centimeters, we may consider this species as an easily recognized, characteristic fossil. Unfortunately, the species has not yet been discovered in many of the localities of the Midwayan.

*Occurrence.*—Midwayan (Clayton limestone): Owl Creek, $2\frac{3}{4}$ miles northeast of Ripley, Mississippi (common); Mabelvale, near Little Rock, Arkansas (very rare).

*Cotypes.*—Cat. No. 63789, U.S.N.M.

### CONOPEUM WILCOXIANICUM, new species.

Plate 9, figs. 1–7.

*Description.*—The zoarium is incrusting, of one or more lamellae, or free and bilaminate. The zooecia are distinctly elongated, elliptical, or pyriform: the mural rim is flat, finely granulated, proximally widened. The opesium is anterior, elliptical or pyriform, entire or denticulated. The interopesial cavities are distinct, lozenge shaped. There are two distal impressions.

*Measurements.*—Opesia $\left\{\begin{array}{l} ho=0.26\text{–}0.30 \text{ mm.} \\ lo=0.20\text{mm.}\end{array}\right.$ Zooecia $\left\{\begin{array}{l} Lz=0.40\text{–}0.44 \text{ mm.} \\ lz=0.36 \text{ mm.}\end{array}\right.$

*Affinities.*—This species differs from *Conopeum hoockeri* in the absence of the gymnocyst, from *C. concavum* in its much larger interopesial cavities and from *C. lacroixii* in the width of its mural rim. It is rarely incrusting, while the three species mentioned are always so. Its zooecial length is likewise a little greater, and, furthermore, it does not corrode the substratum, as in *C. hoockeri* and *C. concavum.* Total regeneration occurs rather frequently and manifests itself by a collar bordering the opesia.

*Occurrence.*—Wilcoxian (Bashi formation): Woods Bluff, Alabama (common).

*Cotypes.*—Cat. No. 63831, U.S.N.M.

### CONOPEUM (?) SIMILIOR, new species.

Plate 9, figs. 8, 9.

*Description.*—The zoarium incrusts shells. The zooecia are distinct, elongated, elliptical, separated by a deep furrow: the mural rim is regular, finely granulated, almost flat, a little larger in its proximal portion. The opesium is elliptical, finely crenulated. The calcified zooecia have a linear orifice and a semilunar distal furrow.

*Measurements.*—Opesium $\left\{\begin{array}{l} ho=0.30 \text{ mm.} \\ lo=0.15\text{–}0.18 \text{ mm.}\end{array}\right.$ Zooecia $\left\{\begin{array}{l} Lz=0.40 \text{ mm.} \\ lz=0.30 \text{ mm.}\end{array}\right.$

*Affinities.*—This species resembles *Conopeum lacroixii* exactly in its zooecial form and in its calcified zooecia, but it differs in its smaller micrometric dimensions.

The two specimens found do not bear interopesial cavities, and hence our doubt as to the generic reference. The species requires further examination.

*Occurrence.*—Wilcoxian Bashi formation): Woods Bluff, Alabama (rare).

*Cotypes.*—Cat. No. 63832, U.S.N.M.

### CONOPEUM LACROIXII Busk, 1852.

Plate 13, fig. 9.

1826. *Flustra lacroixii* Audouin, Explication sommaire des planches de Polypes de l'Egypte et de la Syrie, in Savigny's Description de l'Egypte. Histoire Naturelle, pl. 10, fig. 9.

1852. *Membranipora lacroixii* Busk, Catalogue Marine Polyzoa, pt. 1. Cheilostomata, p. 60, pl. 49 and pl. 104, fig. 1.

1880. *Membranipora lacroixii* Hincks, British Marine Polyzoa, p. 129, pl. 17, figs. 5–8.

1900. *Membranipora lacroixii* Robertson, Papers from the Harriman Alaska Expedition, 6, The Bryozoa, Proceedings, Washington Academy Science, vol. 2, p. 323.

1907. *Membranipora lacroixii* Canu, Bryozoaires des terrains tertiaires des environs de Paris, Annales Paleontologie, vol. 1, p. 8.

1908. *Membranipora lacroixii* Robertson, The Incrusting Cheilostomatous Bryozoa of the West Coast of North America, University of California Publications, vol. 4, p. 261, pl. 14, fig. 5.

1908. *Membranipora lacroixii* Canu, Iconographie des Bryozoaires fossiles de l'Argentine, Anales del Museo Nacional de Buenos Aires, vol. 17, p. 251, pl. 1, figs. 8, 9.

1912. *Membranipora lacroixii* Osburn, The Bryozoa of the Woods Hole Region, Bulletin Bureau Fisheries, vol. 30 (1910), p. 227, pl. 22, fig. 28.

1913. *Membranipora lacroixii* Canu, Étude comparée des Bryozoaires Helvetiens de l'Egypte avec les Bryozoaires vivants de la Mediterranée et de la Mer Rouge, Memoires Institut Egyptien, vol. 6, p. 195, pl. 1, figs. 5, 6.

Not *Biflustra lacroixii* Smitt, Floridan Bryozoa, pt. 2. Kongl. Svenska Vetenskaps-Akademiens Handlingar, vol. 11, 1873, p. 18, pl. 4, figs. 85–88.

The collections of American Tertiary bryozoa have yielded a number of examples of this interesting species which is widespread in both the recent and ancient seas.

*Measurements.*—Opesia $\begin{cases} ho=0.32\text{–}0.36 \text{ mm.} \\ lo=0.12\text{–}0.22 \text{ mm.} \end{cases}$ Zooecia $\begin{cases} Lz=0.36\text{–}0.40 \text{ mm.} \\ lz=0.24 \text{ mm.} \end{cases}$

It is not certain that the species described by Busk is that of Audouin. The synonymy of *Membranipora reticulum* given by Pergens in 1887 is absolutely fantastical. To avoid confusion, Canu in 1907 restricted the synonomy to the species described by Busk, including the living form and the few fossil specimens figured. This restriction is still insufficient, as we believe that it is necessary to classify as *Conopeum lacroixii* only those specimens having interopesial cavities with distinct walls and in which the average zooecial length does not exceed 0.40 mm.

*Variations and affinities.*—This species presents two quite distinct aspects. First, the zooecia have their mural rims separated by a deep furrow, and the interopesial cavities are constant and provided with their own individual walls (see figure by Miss Robertson). Second, the zooecia have their mural rims adjacent to each other and their interopesial cavities are present or absent (as figured by Osburn).

In the living specimens these two variations occur on the same zoarium, but the first appears less frequently. Different species may take the second aspect when there are no interopesial cavities. This results in unusual difficulties in the determination of the fossils and requires the greatest care for accurate identification. In case of doubt the conscientious naturalist should remain silent or should figure the specimens.

The lucid spots are rather irregular on the recent specimens. Canon Norman was unable to see them, but Osburn has figured them. We have not observed them in all cases. On the fossils the corresponding distal impressions are very inconstant. They are visible on certain specimens and have disappeared entirely on others. The granulations of the mural rim are very inconstant, and we have observed but a single case of total regeneration.

This species differs from *Conopeum wilcoxianicum* in the thinness of its mural rim, from *C. hoockeri* in the absence of the hump-like gymnocyst, and from *C. concavum* in the absence of the proximal concave cryptocyst. Its zooecia do not excavate the host like the two latter forms.

*Occurrence.*—Claibornian (Lisbon formation): Wautubbee Hills, 4 miles south of Enterprise, Clarke County, Mississippi.

Lower Jacksonian (Moodys marl): Jackson, Mississippi.

Middle Jacksonian: Eutaw Springs, South Carolina.

*Geological distribution.*—Lutetian, Auversian, and Stampian of the environs of Paris (Canu); Miocene of Tunis (Canu); Burdigalian of Gard and of Herault in France (Canu); Helvetian of Italy (Michelin, Seguenza), of Gard, of Herault, and of Touraine in France (Canu); Tortonian of Austria-Hungary (Reuss); Plaisancian of England (Hincks); Quaternary of England (Bell) and of Argentina (Canu).

*Habitat.*—The habitat of this species is still very obscure on account of the difficulty of its determination. It certainly exists in the North Atlantic off the coasts of France, England, Canada, and the United States and in the Pacific off Alaska and California. It has not yet been observed with certainty in the Mediterranean and in the tropical zone. *Bifustra lacroixii* Smitt found off Florida appears to be a different species, and Osburn, who has rediscovered Smitt's species, also doubts its identity.

*Conopeum lacroixii* does not appear to inhabit the great depths, but it is common near the shores.

*Plesiotype.*—Cat. No. 63845, U.S.N.M.

### CONOPEUM TUBEROSUM, new species.

Plate 19, figs. 6, 7.

*Description.*—The zoarium incrusts oysters. The ancestrular zooecia are isolated. The zooecia are elongated, distinct, elliptical, or pyriform; the gymnocyst is inconstant, small, convex, bearing very often a small *tuberosity;* the mural rim is wide, flat, finely striated, with an acute termen, a little enlarged at the base. The opesium is large, elliptical, very finely crenulated. The interopesial cavities are irregular, inconstant, triangular, or lozenge-shaped.

*Measurements.*—Opesium $\left\{\begin{array}{l} ho=0.22\text{–}0.26\text{ mm.} \\ lo=0.14\text{–}0.16\text{ mm.} \end{array}\right.$ Zooecium $\left\{\begin{array}{l} Lz=0.40\text{ mm.} \\ lz=0.28\text{–}0.30\text{ mm.} \end{array}\right.$

*Variations.*—The aborted zooecia are closed with a median pore. The ancestrula is elliptical and very small. The gymnocyst is more developed on the zooecia close to the ancestrula; here, the frontal tuberosity is absent and the difference from *Electra* is indistinguishable. The characteristic interopesial cavities are developed far from the ancestrula on the wider parts of the zoarium.

*Affinities.*—This species differs from *Conopeum hoockeri* Haime, 1850, in its much smaller frontal tuberosity and in its wider mural rim.

It differs from *Conopeum concavum* in its convex gymnocyst, and its mural rim less enlarged at the base and not concave.

*Occurrence.*—Lower Jacksonian (Moodys marl): 2½ miles north of Robert, Newton County, Mississippi (rare).

*Holotype.*—Cat. No. 63868, U. S. N. M.

### CONOPEUM HOOCKERI Haime, 1850.

Plate 19, figs. 8–10.

1850. *Membranipora hoockeri* Haime in D'Archiac's Description des animaux fossiles du groupe nummulitique de l'Inde, Mémoires Société Géologique France, ser. 2, vol. 3, p. 227, pl. 36, fig. 5.

1869. *Membranipora hoockeri* Reuss, Die fossilen Anthozoen und Bryozoen der Schichtengruppe von Crosaro, Denkschriften der k. Akademie der Wissenschaften, Wien, vol. 29, p. 40, pl. 36, fig. 14.

1891. *Membranipora hoockeri* Waters, North Italian Bryozoa, Quarterly Journal Geological Society, London, vol. 47, p. 13.

*Description.*—The zoarium incrusts shells. The zooecia have a marked luster and are distinct, elongate, elliptical, somewhat narrowed posteriorly; the mural rim is very thin, and sharply outlined, little enlarged at the base; the gymnocyst is very convex. The opesium is regular in outline and elliptical. The interopesial cavities are fusiform but rarely developed. The dorsal bears two distal impressions which are excavated in the substratum. There is a distal septula and two septulae are on each lateral wall.

*Measurements.*—Opesia $\begin{cases} ho=0.30\text{–}0.31 \text{ mm.} \\ lo=0.18\text{–}0.20 \text{ mm.} \end{cases}$ Zooecia $\begin{cases} Lz=0.36\text{–}0.38 \text{ mm.} \\ lz=0.24 \text{ mm.} \end{cases}$

*Affinities.*—We have been unable to find Haime's original specimens in the Museum of Natural History of Paris and verify the determination of Reuss. There are some differences between our specimens and Reuss's figure which does not indicate a hump-like, very constant gymnocyst, and in which no interopesial cavities are shown. Moreover, Waters indicates an opesium 0.35 mm. long, whereas our own specimens measure only 0.31 mm. These are slight differences, and it would be ridiculous to form a new species for four one-hundredths of a millimeter.

On the other hand, the species is quite variable itself. The hump-like gymnocyst which is its fundamental characteristic, is often little developed and sometimes suppressed entirely; again, the zooecia are not always separated by a furrow and the neighboring mural rims are closely adjacent.

The zooecia are very fragile; when they have disappeared, an elliptical cavity is left on the substratum, as if the latter had been eroded. *Conopeum concavum* also possesses this peculiarity; but even when occurring together on the same shell, the two species can not be confounded, since the latter is provided with a concave cryptocyst and has no elevated gymnocyst.

Again, this species differs from *Conopeum wilcoxianicum* in the thinness of its mural rim, and from *C. lacroixii* in the rare occurrence of its interopesial cavities.

*Occurrence.*—Lower Jacksonian (Moodys marl): Jackson, Mississippi (rare).

*Geological distribution.*—Nummulitic limestone of India (Haime); Priabonian of Vicentin (Reuss, Waters).

*Plesiotype.*—Cat. No. 63869, U. S. N. M.

### CONOPEUM CONCAVUM, new species.

Plate 19, figs. 11–13.

*Description.*—The zoarium consists of large colonies incrusting shells. The zooecia are distinct, elongated, elliptical; the mural rim is very thin, but it is much enlarged proximally, forming a true cryptocyst, always *concave*. The opesium is regular and elliptical. The interopesial cavities are large, triangular; they often join each other and become confluent. The dorsal which excavates in the substratum, bears two impressions and two distal septulae.

*Measurements.*—Opesia $\begin{cases} ho=0.28\text{–}0.32 \text{ mm.} \\ lo\ \ 0.18\text{–}0.20 \text{ mm.} \end{cases}$ Zooecia $\begin{cases} Lz=0.36\text{–}0.40 \text{ mm.} \\ lz=0.24 \text{ mm.} \end{cases}$

*Affinities.*—Like *Conopeum hoockeri* this species appears to excavate a place for itself in the substratum, but it presents furthermore some remarkable peculiarities. The opesium of certain zooecia is closed by a perforated lamina. In the articulated species, such zooecia correspond to the radicular pores, but here we are totally ignorant of their function. On other zooecia there is a genuine cryptocyst and an aperture closed by a calcified operculum. Finally, total regeneration manifests itself by a secondary mural rim within the opesium.

This species differs from *Conopeum wilcoxianicum* in its thin mural rim, from *C. hoockeri* in its concave cryptocyst and its interopesial cavities, and from *C. lacroixi* in its concave cryptocyst.

*Occurrence.*—Lower Jacksonian (Moodys marl): Jackson, Mississippi (rare). Vicksburgian (Byram marl): Vicksburg, Mississippi (rare).

*Cotypes.*—Cat. No. 63870, U.S.N.M.

### CONOPEUM LAMELLOSUM, new species.

Plate 20, figs. 1–9.

*Description.*—The zoaria are large undulating fronds formed of multiple lamellae growing back to back. The zooecia are distinct, somewhat elongate, elliptical; the mural rim is flat, finely punctate, projecting distally, and enlarged at the base into a small cryptocyst. The opesium is regular, elliptical, entire or very finely crenulated. On the dorsal olocyst there are two large distal impressions. The very large distal septula is double in the primoserial zooecia. There are three septulae to each lateral wall. The interopesial cavities are very small, triangular, and rather constant.

*Measurements.*—Opesia $\left\{\begin{array}{l} ho=0.24\text{–}0.26 \text{ mm.} \\ lo=0.20\text{–}0.22 \text{ mm.}\end{array}\right.$ Zooecia $\left\{\begin{array}{l} Lz=0.32\text{–}0.36 \text{ mm.} \\ lz=0.30 \text{ mm.}\end{array}\right.$

*Variations.*—The young zooecia are the more perfect; their mural rim is thin; the large distal septula and the impressions are quite visible (fig. 6). The other zooecia have a mural rim enlarged at the base (fig. 8). The primoserial zooecia are engendered, following the rule, by a zooecium of larger dimensions (figs. 6, 8).

The origin of the multiplicity of the lamellae is quite remarkable. On the zoarium may be perceived a sort of subcolony, one superimposed upon the other, which does not arise from one fixed larva. When the two distal septulae are not on the same plane (fig. 5), the uppermost septula corresponds to another higher lamella of zooecia covering the normal one and the first of these zooecia is like an ancestrula of the subcolony which comes forth then as a spiral. This disposition is clearly visible on figure 5.

Deformed zooecia are common. They result quite often from the meeting of two subcolonies (figs. 3, 4). Sometimes they appear on the zoarium as zooecia wanting in vigor and incapable of engendering a new zooecium (fig. 3); then the two lateral lines are rejoined above them. Their forms are very capricious and escape all analysis.

The zoarial lamellae are intimately united because of their formation by subcolonies. Sometimes, however, the lamellae back to back are separable (fig. 7). The dorsal then bears very remarkable, long, prismatic lines on which the zooecia are invisible.

The lateral walls bear three large septulae.

*Affinities.*—This species differs from *Conopeum arborescens* in its zoarial form and its elliptical opesium. On account of its large zoarial dimensions it is a striking and good guide fossil, and it may be determined easily in the field.

*Occurrence.*—Lower Jacksonian (Moodys marl): Various localities about Jackson, Mississippi (common); 2½ miles north of Robert, Mississippi (common).

*Cotypes.*—Cat. No. 63872, U. S. N. M.

## **CONOPEUM ARBORESCENS, new species.**

Plate 20, figs. 10–16.

*Description.*—The zoaria encrust algae, surrounding them with many superimposed lamellae, and thus forming free, irregular, *branched*, hollow masses. The zooecia are large, separated by a ridge, elongated, elliptical, or pyriform; the mural rim is flat and very little enlarged at the base. The opesium is oval. The interopesial cavities are very small, constant, elliptical, or triangular.

*Measurements.*—Opesia $\left\{\begin{array}{l} ho=0.30\text{–}0.32 \text{ mm.} \\ lo=0.18 \text{ mm.}\end{array}\right.$ Zooecia $\left\{\begin{array}{l} Lz=0.46\text{–}0.50 \text{ mm.} \\ lz=0.30 \text{ mm.}\end{array}\right.$

*Variations and affinities.*—Like *Conopeum lamellosum*, this species presents on its zoarial surface subcolonies which do not originate from a larva, but instead from the especial proliferation of a subjacent zooecium (fig. 12). These develop chiefly at the bifurcations of the algae, which are the parts most constant and least susceptible to growth which might disorganize the zoarium. In tangential thin sections the interopesial cavities have special walls (fig. 16). On the inner face of the zoarium the zooecia are elliptical and provided with a distal collar (fig. 14).

The mural rims are adjacent, but may be sometimes separated by a very small furrow. The marginal zooecia are deformed wherever the subcolonies meet. On certain zoaria there are some zooecia bearing a kind of gymnocyst rather well developed; again the interopesial cavities sometimes have the form of prominent and pointed avicularia.

This is a good-sized fossil, and its large zoarial dimensions will aid in its determination even in the field.

*Conopeum arborescens* differs from *C. lamellosum* in the form of its zoarium, in the oval shape of the opesium, in the rarity of furrows separating the zooecia, and in the greater thickness of the mural rim.

*Occurrence.*—Lower Jacksonian (Moodys marl): Jackson, Mississippi (common); 2½ miles north of Robert, Mississippi (common).

*Cotypes.*—Cat. No: 63873, U.S.N.M.

### Genus HELIODOMA Calvet, 1907.

1907. *Heliodoma* CALVET, Bryozoaires Expédition Scientifique du *Travailleur* et du *Talisman*, p. 396.

The zooecia, with frontal provided with a membraneous area, are arranged following two concentric spiral series in which they alternate, separated by a spiral series of vibracula (Calvet).

*Genotype.—Heliodoma implicata* Calvet, 1907. Recent.

The two genera *Cupuladria* and *Heliodoma* differ only in the place of the vibracula. They can be maintained only if it is proved that the function of the vibraculum is different in them. The name of *Heliodoma* would then have the right of priority.

### Genus MEMBRANIPORINA Levinsen, 1909.

1909. *Membraniporina* LEVINSEN, Morphological and Systematic Studies on the Cheilostomatous Bryozoa, p. 145.

Membranipores exhibiting neither ovicells nor avicularia.

*Membraniporina* is not a true genus, but is simply an artificial grouping proposed by Levinsen for the reception of species incompletely described or of which we have insufficient information to place them more definitely.

#### MEMBRANIPORINA RIMULATA Ulrich, 1901.

Plate 1, figs. 1, 2.

1901. *Membranipora rimulata* ULRICH, Maryland Geological Survey, Eocene, p. 211, pl. 60, figs. 1, 2.

*Original description.*—"Zoarium adnate, forming a thin, single sheet of indefinite extent. Zooecia hexagonal in form, arranged quincuncially, with the longitudinal rows generally very regular. Apertures occupying the whole of the large opesium, quite regularly ovate in shape. Rim or interapertural space narrower than the opesia, rounded, sometimes angular in the middle, but oftener with a depressed interzooecial suture line, marked with close transverse lines or wrinkles. Taking the place of an ordinary zooecium, isolated cells, or, more commonly, two or three in longitudinal sequence, occur which differ from the rest in having a convex cover with a narrow median slit, and above the slit a linear crescentic impression. These cells may represent an unusual type of ooecia, but more probably are to be considered as a form of vicarious avicularia or vibracula.

"The specimens upon which the species is founded are divisible into two varieties, one with smaller zooecia and opesia and thicker walls than the other. Measuring longitudinally the former has four and one-half zooecia in 2 mm., the other only three and a half. Diagonally one has six, the other five in the same space. Thickness of zoarial sheet not exceeding 0.2 mm."

A restudy of the types shows Ulrich's description to be exact. Besides the abnormal zooecia pointed out by this author we have noted certain zooecia with double mural rim, these having undergone total regeneration. It is still impossible to place this species generically because neither ovicell, avicularia, nor interopesial cavities have been observed. The rarity of the specimens does not permit the determination of the occurrence of dietellae.

*Measurements.*—Opesia $\left\{\begin{array}{l} ho=0.32 \text{ mm.} \\ lo=0.20 \text{ mm.} \end{array}\right.$ Zooecia $\left\{\begin{array}{l} Lz=0.50 \text{ mm.} \\ lz=0.30 \text{ mm.} \end{array}\right.$

*Occurrence.*—Lowest Eocene (Bryozoan bed at base of Aquia formation): Upper Marlboro, Maryland (very rare).

### MEMBRANIPORINA CANALIFERA, new species.

Plate 3, figs. 9, 10.

*Description.*—The zoarium is incrusting shells. The zooecia are little distinct, the neighboring mural rims being intimately joined together; the mural rim is hollowed and contains a circular *canal* about the opesium, which is elliptical and median.

*Measurements.*—Opesia $\left\{\begin{array}{l} ho=0.30 \text{ mm.} \\ lo=0.20\text{–}0.25 \text{ mm.} \end{array}\right.$ Zooecia $\left\{\begin{array}{l} Lz=0.37\text{–}0.42 \text{ mm.} \\ lz=0.30\text{–}0.35 \text{ mm.} \end{array}\right.$

*Variations.*—This species is well characterized by its circular canal, the use of which is unknown. Perhaps it contained glands analogous to those which Waters[1] has described in *Adenifera* (*Membranipora*) *armata* Haswell, 1880. In the young zooecia this canal is invisible and closed. The calcified zooecia have a small linear orifice.

It is impossible to class this species generically, for neither ovicell nor interopesial cavities have been observed.

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[1] 1913. Waters, Marine Fauna of British East Africa and Zanzibar, Cheilostomata. Proceedings Zoological Society, London, 1913, p. 486, pl. 71, fig. 91.

*Occurrence.*—Midwayan (Clayton limestone): One mile west of Fort Gaines, Georgia (rare): Luverne, Crenshaw County, Alabama (rare).

*Holotype.*—Cat. No. 63790, U. S. N. M.

### MEMBRANIPORINA SINESOLUM, new species.

Plate 19, fig. 5.

*Description.*—The zoarium incrusts oysters; the zooecia are grouped in linear, axial series, emitting laterally zooecia arranged in quincunx. The zooecia are distinct, elongated, elliptical or oval, separated by a deep furrow; the gymnocyst is very small, inconstant, smooth, convex; the mural rim is very thin, flat, slightly enlarged at the base.

*Measurements.*—Opesium $\left\{\begin{array}{l} ho=0.40 \text{ mm.} \\ lo=0.20 \text{ mm.} \end{array}\right.$ Zooecia $\left\{\begin{array}{l} Lz=0.44\text{–}0.50 \text{ mm.} \\ lz=0.30 \text{ mm.} \end{array}\right.$

*Affinities.*—This species has the simplicity of structure of *Membraniporina laxa* Reuss 1869; there is no *basal olocyst*, or, better, it is of extreme tenuity and the substratum is entirely visible. *M. sinesolum* differs, however, in its smaller dimensions (*ho*=0.40 mm. and not 0.50 mm.) and in its more regular zooecia.

This is perhaps *Biflustra lacroixi* Smitt, 1872, which was incorrectly determined. However, we are unable to make comparisons, as we have not discovered the recent species or measured the types.

*Membraniporina sinesolum* differs from *Membranipora capillimargo* Canu, 1911, from the Rocanean of Argentina, in its larger micrometric dimensions (*Lz*=0.44–0.50 mm. and not 0.35–0.42 mm.). *Membraniporina laxa* Reuss 1869, *Membraniporina capillimargo* Canu, 1911, *Biflustra lacroixi* Smitt, 1872 and *Membraniporina sinesolum*, new specis, form a natural group of very great simplicity of structure. Unfortunately we lack recent specimens for study.

*Occurrence.*—Lower Jacksonian (Moodys marl): $2\frac{1}{2}$ miles north of Robert, Newton County, Mississippi (rare).

*Holotype.*—Cat. No. 63876, U. S N. M.

### MEMBRANIPORINA LAXA Reuss, 1869.

Plate 13, fig. 16.

1864. *Membranipora subtilimargo* Reuss, Ueber Anthozoen und Bryozoen des Mainzer Tertiarbeckens, Sitzungsberichte der k. Akademie der Wissenchaften, Wien, vol. 50, Abth. 1, p. 630, pl. 9, fig. 5.

1869. *Membranipora laxa* Reuss, Die fossilen Anthozoen und Bryozoen der Schichtengruppe von Crosaro, Denkschriften der k. Akademie der Wissenschaften, Wien, vol. 29, Abth. 1, p. 252, pl. 36, fig. 14.

1904. *Membranipora laxa* Canu, Exploration scientifique de la Tunisie, Etude des Bryozoaires tertiaires, p. 17, pl. 34, fig. 18.

*Affinities.*—The figured specimen, which is the only one collected, is only moderately well preserved, but it presents some interesting peculiarities. There is no dorsal olocyst, the substratum is visible in the opesium, and the calcification is reduced entirely to the lateral walls. Total regeneration manifests itself in a very thin mural rim within the opesium.

The dimensions of the opesium are 0.50 mm. to 0.55 mm. by 0.40 mm. measurements which are very close to those of *Membranipora laxa* from Tunis as figured by Canu. The granulations of the mural rim are much rarer than in the specimens from Tunis; they must be very irregular in occurrence, for Reuss did not mention them at all. If our American specimen be correctly determined, it appears here in a lower geologic horizon than in Europe.

This species is very close to *Membranipora filum* Jullien,[1] but its dimensions are smaller and its zooecia are relatively more elongated in which it approaches the specimens cited by Calvet. It is evident that the great structural simplicity of such species makes their determination a matter of great care and of which one can not be exactly certain without the study of numerous specimens.

*Occurrence.*—Claibornian (Gosport sand): 1 mile southwest of Rockville. Clarke County, Alabama (very rare).

*Geological distribution.*—Priabonian of Vicentin (Reuss, Waters); Chattian (=Casselian) of Germany (Reuss); Eocene of Tunis (Canu).

*Plesiotype.*—Cat. No. 63848, U.S.N.M.

### MEMBRANIPORINA CLAVIFORMIS, new species.

Plate 19, fig. 14.

*Description.*—The zoarium is free and *club shaped*, quite slender in the lower part, composed of zooecia disposed about an imaginary axis. The zooecia are large, elongate, somewhat indistinct because their mural rims are often confluent; the mural rim is thick, round, smooth. The opesium is median and elliptical. Between the superior opesia there are small triangular cavities without special walls. The larger zooecia measure 0.70 mm. by 0.24 mm.

*Affinities.*—Only the single specimen figured has been discovered. It bears a resemblance to *Farcimia*, but we have been able to observe neither articulation nor endozooecial ovicells; moreover, there are six longitudinal series of zooecia. It is necessary therefore to await more abundant material before the generic position can be determined.

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[1] The bibliography of this recent species is as follows:

1872. *Biflustra lacroixi* SMITT, Floridan Bryozoa, Kongl. Svenska Vetenskaps-Akademiens Handlingar. vol. 10, No. 11, p. 18, pl. 4, figs. 85–88.

1902. *Membranipora reticulum* CALVET, Bryozoaires des cotes de Corse, Travaux de l'Institut de Zoologie de Université de Montpelier, ser. 2, Mem. 12, p. 14.

1903. *Membranipora filum* JULLIEN, Bryozoaries provenant des Campagnes de *l'Hirondelle*, p. 41, pl. 5, fig. 4.

1914. *Membranipora lacroixii* OSBURN, The Bryozoa of the Tortugas Islands, Florida, Publication Carnegie Institution of Washington, No. 182, p. 193.

Smitt's figures, 85–87, indicate clearly the presence of triangular interopesial cavities with individual walls. Jullien thought this was an error, and that the species bore two spines placed on the distal triangular parts of the zooecium. Canu does not believe that Smitt could have committed such an error in figuring the form. Osburn has collected from the Tortugas Islands a specimen which he states is similar to Smitt's figures, and which presents the usual characters of *Conopeum lacroixii*. But without doubt the species figured by Smitt is provided with a mural rim much narrower than Busk's species, and for this reason it will perhaps be convenient to consider it a distinct species. The species of Jullien and Calvet is also very probably another.

*Occurrence.*—Middle Jacksonian (Castle Hayne limestone): Wilmington, North Carolina (very rare).

*Holotype.*—Cat. No. 63871, U. S N. M.

### MEMBRANIPORINA BENJAMINI Canu and Bassler, 1917.

Plate 21, fig. 1.

1917. *Membraniporina benjamini* Canu and Bassler, Synopsis of American Early Tertiary Cheilostome Bryozoa, Bulletin 96, United States National Museum, p. 11, pl. 1, fig. 1.

*Description.*—The zoarium is incrusting. The zooecia are large, elongate, elliptical, and distinct; the mural rim is rounded, smooth, everywhere of equal width. The opesium is median, elliptical, entire. In the vicinity of the septulae there is often an incomplete small canal.

*Measurements.*—Opesia $\begin{cases} ho=0.57 \text{ mm.} \\ lo=0.30 \text{ mm.} \end{cases}$ Zooecia $\begin{cases} Lz=0.65\text{–}0.70 \text{ mm.} \\ lz=0.40\text{–}0.45 \text{ mm.} \end{cases}$

*Affinities.*—Only the fragment figured, which is of considerable interest, has been found. In the proximal part of the zooecium in front of each septula there is a sort of incompletely calcified tubule, serving probably to protect the mesenchymatous filaments which pass from one zooecium to another.

This interesting species is named after Dr. Marcus Benjamin, the efficient editor of the United States National Museum, to whom we are indebted for many courtesies.

*Occurrence.*—Middle Jacksonian: Rich Hill, 5¼ miles southeast of Knoxville, Crawford County, Georgia (very rare).

*Holotype.*—Cat. No. 62567, U.S.N.M.

### MEMBRANIPORINA TUBULOSA, new species.

Plate 80, figs. 2–7.

*Description.*—The zoarium is unilaminar, *tubular*, and incrusts very small algae. The zooecia are distinct, elongated, hexagonal; the mural rim is level, but little elevated, much enlarged at the base to form a concave cryptocyst. The opesium is anterior, elliptical, entire; the lateral walls bear two small septulae.

*Measurements.*—Opesia $\begin{cases} ho=0.20\text{–}0.22 \text{ mm.} \\ lo=0.17 \text{ mm.} \end{cases}$ Zooecia $\begin{cases} Lz=0.40\text{–}0.45 \text{ mm.} \\ lz=0.30\text{–}0.32 \text{ mm.} \end{cases}$

*Affinities.*—The bifurcation of the zoarium corresponds to that of the alga which served as a substratum. At this bifurcation there is often a giant zooecium. The calcified zooecia have a concave cryptocyst perforated by a large round pore. It appears to us that endozooecial ovicells may be present, but as we are not able to confirm the observation by a dissection it is necessary to await better specimens before placing the species finally.

In its exterior aspect this species is close to *Acanthodesia* (*Membranipora*) *savartii* Audouin, 1826, but it differs in its smaller micrometric dimensions, its tubular zoarium, and in the absence of an opesial denticle. In considering this form of zoarium it is necessary to admit that in order to attain such a shape there is necessary, first, an alga very soft and incapable of breaking the armor formed about it by the bryozoan, and, second, either the base or the joint of the incrusted alga has reached its greatest resistant growth, is incapable of further growth, or is dead. We are without means of elucidating such problems, but one must admire the remarkable selective instinct of the larva which would always choose an identical substratum and could anticipate its nondevelopment. We will dwell many times on these marvelous larval activities in the course of this work. It is greatly to be desired that their study will be undertaken by the young zoologists.

*Occurrence.*—Vicksburgian ("Chimney rock" of Marianna limestone): 1 mile north of Monroeville, Alabama (very common); 2½ miles north of Millry, Washington County, Alabama (rare).

*Cotypes.*—Cat. No. 64230, U.S.N.M.

### MEMBRANIPORINA ARCANA, new species.

Plate 80, figs. 8–11.

*Description.*—The zoarium is a fragile, free network. The zooecia are very elongate, little distinct, nearly elliptical; the mural rim is very thin at the top, enlarged below, curved, almost smooth. The opesium is large, elliptical, entire. There is no calcified dorsal face.

*Measurements.*—Zooecia $\begin{cases} Lz=1.00 \text{ mm.} \\ lz=0.40 \text{ mm.} \end{cases}$

*Affinities.*—This species is a true mystery. As it is very fragile and imperfectly calcified we would be justified in classifying it in *Membranipora*—that is to say, in the *Membranacea* group. But we have discovered a sort of ovicell (?) situated in the lower part of the zooecium and deforming its proximal part. This problematic cavity has never been observed before. We are thus compelled to class it in the genus *Membraniporina*, with species insufficiently studied or poorly understood.

*Occurrence.*—Vicksburgian ("Chimney rock" of Marianna limestone): One mile north of Monroeville, Alabama (rare).

*Cotypes.*—Cat. No. 64231, U.S.N.M.

### ACANTHODESIA, new genus.

Greek: Acanthodes, full of bristles.

No ovicell. The opesium is garnished laterally by small spinous processes and inferiorly by a serrate denticle. Fifteen tentacles.

*Genotype.*—*Acanthodesia* (*Flustra*) *savartii* Savigny-Audouin, 1826.

*Range.*—Lutetian–Recent.

Another species of this new genus is *Membranipora limosa* Waters, 1908. Waters classified the genotype in the same group as *Membranipora hians* Hincks, 1885. This is incorrect, since *Flustra savartii* is deprived of opesiules, and its large retractor muscle of the polypide inserted on the median axis of the zooecium assures the symmetry of the opesium; moreover, there is no ocivell.

The spinous processes are of the same nature as those of the genera *Hemiseptella* Levinsen, 1909, and *Cupularia* Defrance, 1821, but they are very inconstant; in fact, they have not been noted on the recent specimens, nor are they very frequent on the fossils. On the contrary, the serrate denticle is rarely found in the fossil examples.

### ACANTHODESIA SAVARTII Audouin, 1826.[1]

Plate 21, figs. 2–4.

1826. *Flustra savartii* AUDOUIN, Explication sommaire des planches de l'Egypte et de la Syrie, in Savigny's description de l'Egypte, Histoire Naturelle, vol. 3, Paris, p. 240, pl. 10, fig. 10.

1907. *Membranipora savartii* CANU, Bryozoaires des terrains tertiaires des environs de Paris, Annales Paleontologie, vol. 2, p. 6, pl. 1, fig. 1.

1908. *Membranipora savartii* CANU, Iconographie des Bryozoires fossiles de l'Argentine, Anales del Museo Nacional de Buenos Aires, vol. 17, p. 252, pl. 2, figs. 5, 6.

1909. *Membranipora savartii* WATERS, Reports on the Marine Biology of the Sudanese Red Sea, XII, Journal Linnean Society, London, vol. 31, p. 137, pl. 11, figs. 8–13.

1913. *Membranipora savartii* WATERS, Marine Fauna of British East Africa and Zanzibar. Bryozoa, Cheilostomata, Proceedings Zoological Society London, 1913, p. 486.

1914. *Membranipora savartii* OSBURN, The Bryozoa of the Tortugas Islands, Florida, Publication Carnegie Institution of Washington, No. 182, p. 1941.

*Measurements.*—Opesia $\begin{cases} ho=0.26\text{–}0.32 \text{ mm.} \\ lo=0.20\text{–}0.26 \text{ mm.} \end{cases}$ Zooecia $\begin{cases} Lz=0.36\text{–}0.44 \text{ mm.} \\ lz=0.18\text{–}0.36 \text{ mm.} \end{cases}$

*Variations.*—The American forsil specimens are unilamellar and incrust other bryozoa, chiefly the Cellopores. After rubbing away the zoarial surface we have observed only one distal septula. The micrometric variations between one specimen and another are considerable. Our specimens correspond exactly to those from the environs of Paris, and are almost the same as those from Egypt and from the English Crag, but they differ a little from examples dredged in the recent seas. We have figured the extreme forms, but our fossils show all of the intermediate stages.

The opesial denticle is rarely observed on the fossils on account of its very great fragility. Nevertheless, these denticles are very clearly preserved on a specimen from the Vicksburgian of Jasper County, Mississippi (fig. 4).

The vigor and resistance of this species is extraordinary. Quite cosmopolitan in the existing seas, it was present even in the Eocene seas. Unfortunately, we are still ignorant of its larval system. It appears sensitive to bathymetric variation, implying an elementary hydrostatic system, and the absence of powerful means of oxygenation.

*Occurrence.*—Vicksburgian ("Chimney rock" of Marianna limestone): Three miles southeast of Vosburg, Jasper County, Mississippi (rare); 1 mile north of Monroeville, Alabama (very common).

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[1] Savigny having become blind, the explanation of his plates was prepared by Audouin in 1826 Savigny's plates were published in 1812.

*Geological distribution.*—The foreign occurrences are as follows: Lutetian of the environs of Paris (Canu); Latdorfian of Germany (Reuss, Stoliczka); Rupelian of Germany (Reuss, Schreiber); Chattian of Germany (Reuss, Philippi, Roemer); Miocene of Australia (Waters, MacGillivray); Helvetian of the Herault in France (Canu), of Italy (Neviani), of Egypt (Canu); Zanclean of Italy (Seguenza); Plaisancian of England (Busk), of Belgium (Lorie), of Italy (Manzoni); Astian of Italy (Seguenza); Quaternary of Italy (Sequenza) and of Argentina (Canu).

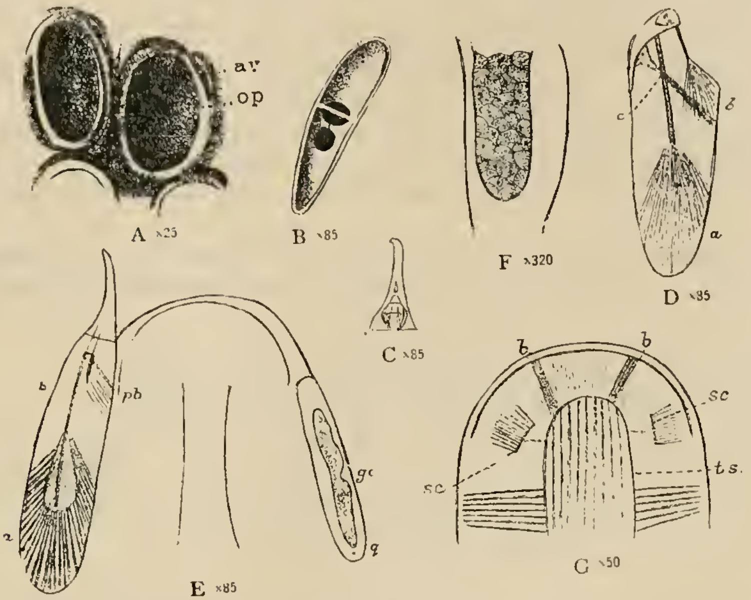


FIG. 26.—Genus *Adenifera* Canu and Bassler, 1917.

A–G. *Adenifera armata* Haswell, 1880. A. Several zooecia, × 25; *av*, avicularium, *op*, opesium. B. Avicularium, × 85. C. Mandible of the avicularium, × 85. D. Decalcified avicularium showing retractor muscles (*a*), divaricator (*b*), with tendon attached to the maudible in the middle of the base, and the "peculiar body" (*c*), × 85.

E. Decalcified zooecium showing the avicularian chamber on the left with muscles, as in fig. D, and the glandular chamber (*gc*) on the right, × 85.

F. Lower portion of lateral gland, × 320.

G. Opercular region, seen from the interior, × 50. The opercular muscle is attached to a linear sclerite (*sc*) on the membranous operculum, and from the sclerite there is also a muscular band to the tentacular sheath (*t. s.*). Two protoplasmic bands pass to the distal septula. (A–G after Waters, 1913.)

*Habitat.*—The living forms are found in the Atlantic off Florida, in the Pacific off Australia, in the Indian Ocean at Zanzibar and Ceylon, and in the Red Sea, where they have been brought up from depths of 18 to 54 meters. In the Gulf of Florida they have been found at depths of 16 to 47 meters.

*Plesiotypes.*—Cat. Nos. 63874, 63875, U.S.N.M.

## Genus ADENIFERA Canu and Bassler, 1917.

1917. *Adenifera* CANU and BASSLER, Synopsis of American Early Tertiary Cheilostome Bryozoa, Bulletin 96, United States National Museum, p. 12.

With a distal glandular penthouse.

*Genotype.*—*Membranipora armata* Haswell, 1880.

*Range.*—Jacksonian-Recent.

In 1914 Waters studied the genotype and wrote: "This form can not remain under *Membranipora*, though I am not suggesting that it is *Petralia*, but call attention to various similar characters in forms placed far asunder."

The hydrostatic zoarial system well known in the Petraliidae is not limited to this family, but occurs frequently in many other bryozoa. We have noted the fact that the life of bryozoa commensal upon algae is in intimate relation with the substratum.

Waters noted 30 tentacles in *Membranipora armata*, but this number occurs very rarely. We are in ignorance regarding the family to which this genus should be referred.

The species which may be classed in this genus are as follows:

*Adenifera* (*Membranipora*) *armata* Haswell, 1880. Recent.
*Adenifera* (*Membranipora*) *nigrans* Hincks, 1882. Recent.
*Adenifera* (*Membranipora*) *marginella* Hincks. 1884. Recent.
*Adenifera* (*Membranipora*) *striata* MacGillivray, 1904. Tertiary of Australia.

### ADENIFERA INARMATA Canu and Bassler, 1917.

Plate 21, figs. 5–7.

1917. *Adenifera inarmata* CANU and BASSLER, Synopsis of American Early Tertiary Cheilostome Bryozoa, Bulletin 96, United States National Museum, p. 12, pl. 1, fig. 2.

*Description.*—The zoarium is unilamellar, living upon algae; its lower side bears hydrostatic tuberosities. The zooecia are very large, ogival in form, and distinct; the mural rim is very finely granulated, rounded, enlarged at the base, where it sometimes bears callosities. The opesium is entire, elliptical but somewhat irregular. On the distal part of the mural rim there is an arched pad which is hollow, fragile, and symmetrical, the fore part containing two glands. No avicularia.

*Measurements.*—Opesia $\begin{cases} ho=0.60\text{–}0.66 \text{ mm.} \\ lo=0.50 \text{ mm.} \end{cases}$ Zooecia $\begin{cases} Lz=0.80\text{–}0.90 \text{ mm.} \\ lz=0.60\text{–}0.70 \text{ mm.} \end{cases}$

*Affinities.*—This species differs from *Adenifera striata* MacGillivray, 1904, from the Miocene of Australia, in its much smaller micrometric measurements and in the reduction of its cryptocyst. It differs from the recent *Adenifera armata* in the total absence of a lateral avicularium on the distal arch. Here, again, it may be noted that the Membranipores have not always the simplicity of structure described by the older authors.

*Occurrence.*—Middle Jacksonian: Near Lenuds Ferry, South Carolina (common); Wilmington, North Carolina (very rare).

*Cotypes.*—Cat. No. 62570, U.S.N.M.

### CUPULADRIA, new genus.

No ovicell. The zoarium bears vibracula. No gymnocyst.

*Genotype.—Cupuladria* (*Cupularia*) *canariensis* Busk, 1859.

*Range.*—Miocene–Recent.

The genotype does not belong at all to the genus *Cupularia*, as we now understand the genus, and as it is defined by its type species. There are neither opesiules nor cryptocyst. Previously Smitt, in 1872, classified the genotype more correctly in *Membranipora*, as this genus was then understood. It can not, however, be maintained in this genus, since its significance has been more restricted. We have therefore been obliged to create a new genus, characterized by the presence of vibracula, although these organs of zoarial adaptation may not logically furnish good generic characters. We only add a letter to the primitive term to modify the long synonymy of this species as little as possible.

This genus differs from *Heliodoma* Calvet, 1907, in the absence of a gymnocyst. The absence of an endozooecial ovicell does not permit it to be confused with either *Vibracellina* Canu and Bassler, 1917, or *Setosellina* Calvet, 1907.

### Genus TROCHOPORA D'Orbigny, 1851.

1851. *Trochopora* D'ORBIGNY, Paleontologie française, Terrain Cretace, Bryozoaires, vol. 5, p. 506.

The zoarium has the Lunulites form. The zooecia and the vibracula are arranged in distinct rows. The ancestrular zooecia are either hydrostatic or radicular. The growth of the zoarium is effected by superimposed (unizooecial) disks with the zooecia arranged in single rows. No ovicell. The vibracula are symmetrical.

*Genotype.—Trochopora conica* Defrance, 1833.

*Range.*—Lutetian-Helvetian.

The known species of this genus are as follows:

*Trochopora conica* Defrance, 1833.

*Trochopora ovalis* D'Orbigny, 1851.

*Trochopora subplena* Reuss, 1855.

### TROCHOPORA BOUEI Lea, 1833.

Plate 10, figs. 1–17.

1833. *Lunulites bouei* LEA, Contributions to Geology, p. 189, pl. 6.

1833. *Lunulites duclosii* LEA, Contributions to Geology, p. 190, pl. 6, fig. 203.

1862. *Discoflustrellaria bouei* GABB and HORN, Monograph of the Fossil Polyzoa of the Secondary and Tertiary formations of North America, Journal of the Academy of Natural Sciences of Philadelphia, ser. 2, vol. 5, p. 154.

1862. *Heteractis duclosii* GABB and HORN, Monograph of the Fossil Polyzoa of the Secondary and Tertiary formations of North America, Journal Academy of Natural Sciences of Philadelphia, ser. 2, vol. 5, p. 156, pl. 20, fig. 39.

1890. *Lunulites* (*Discoflustrellaria*) *bouei*, and varieties *concava*, *depressa*, *duclosii*, *tiza*, and *almina*, DE GREGORIO, Monographie de la Faune Eocenique de l'Alabama et surtout de celle de Claimorne de l'Etage Perisien, Annales de Geologie et de Palontologie, livraisons, 7, 8, p. 243, pls. 41, 42.

*Description.*—The zoarium is Lunulites in form, slightly convex, with the inner face concave. The zooecia are elongated, pyriform, distinct; the mural rim is regular, convex, projecting distally. The opesium is pyriform, entire. The ancestrular zooecia are normal or radicular. The vibracula are small, narrow, symmetrical, with neither condyle nor small canal. On the inner face the disks are thinner at the center; they are formed of radial costules with the zooecia in one row and perforated with a line of irregular pores. A large distal septula is present.

*Variations.*—This species is very constant in its zooecial form. The principal variations are produced in the vicinity of the ancestrula, according to the conditions under which the larva becomes fixed. The larva affixes itself as customary on a grain of sand (figs. 11, 13, 14). There are four sorts of ancestrular zooecia. 1. The ancestrula gives rise to normal zooecia and a discoidal zoarium results (figs. 8, 11). 2. The ancestrula engenders a flabelliform zoarium of normal zooecia (variety *duclosii*) (fig. 2). The zoarium then becomes discoidal by the especial proliferation of the lateral rows. 3. The ancestrula gives rise to a discoidal zoarium commencing with radicular zooecia (var. *almina*) (fig. 5), this zone of radicular zooecia being more or less large. 4. The ancestrula gives origin to a flabelliform zoarium uniquely composed of vibracula (fig. 17). The ancestrula may be visible (fig. 8) or immersed (figs. 3, 5). The inner face is also quite variable; very often the primitive flabelliform zoarium is visible (figs. 9, 10); again, it is often covered by the accompanying disks (fig. 16).

The disks piled up to compose the zoarium are much thinner at the center (which preserves the cupuliform aspect of the zoarium) (fig. 16). Frequently broken disks are found showing the construction of the genus very well (figs. 12, 13, 15). In vertical fractures the fibrous texture of the zoarium is quite visible (fig. 14).

*Occurrence.*—Claibornian (Gosport sand): Claiborne, Alabama (very abundant); Gopher Hill, Tombigbee River, Alabama; 1 mile southwest of Rockville, Alabama (very abundant).

Claibornian (Cook Mountain formation): Moseleys Ferry, Caldwell County, Texas (abundant).

Claibornian (Lisbon formation): Wautubbee Hills, 4 miles south of Enterprise, Mississippi (rare).

Lower Jacksonian: 3½ miles southwest of Shell Bluff post office, Georgia (rare).

Lower Jacksonian (Moodys marl): Jackson, Mississippi (abundant).

Vicksburgian (Red Bluff clay): Red Bluff, Wayne County, Mississippi (rare).

*Plesiotypes.*—Cat. No. 63837, U.S.N.M.

### TROCHOPORA TRUNCATA De Gregorio, 1890.

Plate 11, figs. 1–6.

1890. *Lunulites (Discoflustrellaria) bouei*, var. *truncata* DE GREGORIO, Monographie de la Faune Eocenique de l'Alabama et surtout de celle de Claiborne de l'Etage Parisien, Annales de Geologie et de Paleontologie, Livraisons 7, 8, p. 245, pl. 41, figs. 34–41.

*Description.*—The zoarium is a conical Lunulites, solid, formed of successive disks. The zooecia are hexagonal, distinct, arranged in radial and circular rows;

the mural rim is thin, sharp. irregular, and gashed. The opesium is irregular. The ancestrular zooecia never cover the grain of quartz to which the larva affixes itself. The vibracula are not very constant; they are at first very small, increasing in size toward the periphery and becoming primoserial. On the inner face the radial rows are flat, smooth at the center, very porous at the circumference.

*Measurements.*—Zooecia $\begin{cases} Lz=0.20 \text{ mm.} \\ lz=0.15 \text{ mm.} \end{cases}$ Vibracula $\begin{cases} Lv=0.15 \text{ mm.} \\ lv=0.07 \text{ mm.} \end{cases}$

*Affinities.*—This is a very typical *Trochopora* and is the species corresponding to *Trochopora subplena* Reuss 1855, of the European Oligocene. It differs from it, however, in its smaller opesial dimensions ($lz=0.15$ mm. instead of 0.20–0.24 mm.).

When altered by fossilization *Trochopora truncata* is difficult to distinguish from badly preserved examples of *Lunularia ligulata*, with which it very often occurs. The specimens with a flat and perforated base may alone be considered as *Trochopora truncata.*

Vertical sections are not always necessary to discover the heaped-up disks, for they are often visible in partial fractures.

De Gregorio's figures are rather mediocre, but as his text apparently agrees with our specimens, we believe it necessary to adopt his name: "Testa superne truncata plus minusce discoidea. . . . Le type de cette variété s'éloigne beaucoup du type de l'espèce, de sorte qu'on pourrait le considerer comme une espèce differente . . . figs. 34–37 couche détachée de la face inférieure (disk)."

*Occurrence.*—Claibornian (Gosport sand): Gopher Hill, Tombigbee River, Alabama; 1 mile southeast of Rockville, Alabama (rare); Claiborne, Alabama (very abundant).

Claibornian (Cook Mountain formation): Moseleys Ferry, Caldwell County, Texas (abundant).

Lower Jacksonian: 3½ miles southeast of Shell Bluff post office, Georgia (rare).

Lower Jacksonian (Moodys marl): Jackson, Mississippi (abundant).

*Plesiotypes.*—Cat. No. 63838, U.S.N.M.

### Genus OTIONELLA Canu and Bassler, 1917.

1917. *Otionella* Canu and Bassler, Synopsis of American Early Tertiary Bryozoa, Bulletin 96, United States National Museum, p. 13.

The zoarium is discoidal (Lunulites form), with neither ovicell nor radicular and hydrostatic zooecia. The vibraculum is interzooecial, unsymmetrical, auriculated, one lip more prominent than the other. The zooecia are hexagonal and disposed in quincunx on the outer face and in radial lines on the inner side. The ancestrula is as large as the other zooecia and of the same form.

*Genotype.*—*Otionella perforata* Canu and Bassler, 1917.

*Range.*—Campanian, Jacksonian.

*Lunulites mitra* Hagenow, 1839, belongs to this genus.

This genus is a Membranipore with the Lunulites form; that is to say, the colony is discoidal. It is a recognized fact that these Lunulites forms of growth are only the adaptions to a particular mode of existence in sandy facies. We have not observed ovicells on any of our specimens, but we can not affirm their complete absence before studying a much larger number of specimens and making more numerous thin sections.

### OTIONELLA McCALLIEI, new species.

Plate 12, figs. 1, 2.

*Description.*—The zoarium is discoidal, the inner side concave. The zooecia are hexagonal, distinct, separated by a furrow, disposed in irregular quincunx lines; the mural rim is thin at the top, enlarged into a cryptocyst below, smooth, sharp at the summit. The opesium is elongated, elliptical, bordered by a very small collar. The vibraculum is asymmetrical and auriculated, interzooecial, as large as the zooecia. On the inner face the zooecia are disposed in radial lines, perforated with large pores, communicating with the interior of the zooecia.

*Measurements.*—Vibraculum $\begin{cases} Lv=0.25\text{–}0.30 \text{ mm.} \\ lv=0.12\text{–}0.15 \text{ mm.} \end{cases}$

*Affinities.*—The only specimen found is the figured one, which is remarkable in that the ancestrula appears to be double and formed of two large zooecia; this is an illusion, for the true ancestrula is by no means placed in the geometric center of the zoarium. The ribs of the inner face are arranged in radial lines and are independent of the zooecia of the outer face. Nevertheless they ought to communicate with the latter by the tubules, as is the habit in the genus.

This species differs from *Otionella perforata* in its much larger vibraculum and in the much smaller opesial collar.

The specific name is in honor of Dr. R. W. McCallie, State geologist of Georgia, who has taken an active interest in our work and has furnished numerous specimens from his State.

*Occurrence.*—Lower Jacksonian: 3½ miles southeast of Shell Bluff post office, Georgia (very rare).

*Holotype.*—Cat. No. 63839, U.S.N.M.

### OTIONELLA PERFORATA Canu and Bassler, 1917.

Plate 11, figs. 7–19.

1917. *Otionella perforata* CANU and BASSLER, Synopsis of American Tertiary Cheilostome Bryozoa, Bulletin 96, United States National Museum, p. 13, pl. 1, figs. 3, 4.

*Description.*—The zoarium is discoidal with a concave inner face. The zooecia are ogival in shape, broad, distinct, separated by a furrow, disposed in very irregular radial and transverse lines; the mural rim is broad on the sides and below with a projecting summit; the opesium is elliptical, little elongated, nearly orbicular, bordered by a projecting collar. The vibraculum is as large as the zooecium, unsymmetrical and auriculated, rather narrow. On the inner face the radial ribs are *perforated* with numerous pores. There are at least two pairs of large lateral septulae to each zooecium, and only one pair in the vibraculum.

*Measurements.*—Opesium $\left\{\begin{array}{l} ho=0.12 \text{ mm.} \\ lo=0.10 \text{ mm.} \end{array}\right.$ Zooecium $\left\{\begin{array}{l} Lz=0.25 \text{ mm.} \\ lz=0.20\text{–}0.27 \text{ mm.} \end{array}\right.$

Vibraculum $\left\{\begin{array}{l} Lv=0.25 \text{ mm.} \\ lv=0.10 \text{ mm.} \end{array}\right.$

*Variations.*—The lines of zooecia are easily detached from one another. Their edge (fig. 16) shows a minutely furrowed surface in which the furrows radiate from the same center of origin as the lines. As is indicated in figures 11, 12, 13 this center of origin is not necessarily the zoarial center. These furrows represent intercostal canals which are independent of the perforating tubules (fig. 19), the orifices of which are visible at *t* in fig 16. This same figure shows also the large multiporous lateral septulae.

In sections (fig. 19) the zooecia are urceolate, erect, separated by convex partitions. In the same radial line they communicate among themselves by means of a large distal septula (*s. d.*). The tubules (*t*), corresponding to the large pores of the inner face, probably serve for the passage of the mesenchymatous network.

In small zoaria the ribs of the inner face are hollow at their extremities (figs. 13, 14, 15). These hollow spaces were subsequently filled up, for the sections do not indicate these cavities (fig. 19).

The proliferation of the zooecia is not always regular about the ancestrula (fig. 14). A flabelliform colony (fig. 13) is often formed and becomes discoidal by special budding at the ends and on the sides of the lines of zooecia. The tangential section (fig. 17) is not very well oriented, but it is sufficient to show the constitutive elements of the olocyst grouped in radial lines about the opesium.

*Affinities.*—This species differs from *Otionella tuberosa* in the numerous pores which perforate its inner face. The opesial collar is analogous to that which Levinsen has noted in *Membranicellaria;* but we have never observed the endotoichal ovicell of this genus.

*Occurrence.*—Claibornian (Gosport sand): Claiborne, Alabama (common); Gopher Hill, Tombigbee River, Alabama; 1 mile southeast of Rockville, Clarke County, Alabama (common).

Claibornian (Lisbon formation): Wautubbee Hills, 4 miles south of Enterprise, Mississippi (rare).

Lower Jacksonian (Moodys marl): Jackson, Mississippi (common).

*Cotypes.*—Cat. No. 62571, U.S.N.M.

### OTIONELLA TUBEROSA, new species.

Plate 12, figs. 5–15.

*Description.*—The zoarium is discoidal, with a concave inner face. The zooecia are hexagonal, somewhat indistinct, joined by their mural rims, disposed apparently in irregular quincunx; the mural rim is concave, broad, especially at the base. The opesium is elliptical or nearly orbicular and bordered by a prominent collar. The vibraculum is interzooecial, asymmetrical, auriculated, larger than the zooecium.

The inner face is but slightly concave; the radial ribs are smooth and perforated with some small scattered pores or ornamented with large *tuberosities.*

*Measurements.*—Opesium $\left\{\begin{array}{l}ho=0.15\text{ mm.}\\ lo=0.12\text{ mm.}\end{array}\right.$ Zooecium $\left\{\begin{array}{l}Lz=0.25\text{ mm.}\\ lz=0.25\text{ mm.}\end{array}\right.$

Vibraculum $\left\{\begin{array}{l}Lv=0.35\text{ mm.}\\ lv=0.26\text{ mm.}\end{array}\right.$

*Variations.*—The interzooecial sections show that the inner side is very thick and fibrous, and that between the tuberosities there are sometimes very narrow tubules (fig. 9). The tuberosities on the rows of the noncelluliferous face (figs. 10, 12) are not constant (fig. 14), and the same zoarium (fig. 10) shows both smooth and tuberous conditions. Gemmation about the ancestrula is not regular. It is linear at first, and the zoarium becomes discoidal by the special budding along lateral lines (fig. 10).

In tangential section (figs. 7, 13) the mural rim is seen to be formed of olocystal elements grouped in radial lines around the opesium. A tangential section of the inner face (fig. 6) shows olocystal nuclei corresponding to the tuberosities. The ribs are separated by a white line.

*Affinities.*—The opesial collar is similar to that described by Levinsen in *Membranicellaria;* but we have not observed ovicells.

This species differs from *Otionella perforata* in the tuberosities which ornament its noncelluliferous side and in its vibracula, which are larger than the zooecia.

*Occurrence.*—Claibornian (Cook Mountain formation): Moseleys Ferry, Caldwell County, Texas (rare).

Lower Jacksonian (Moodys marl): Jackson, Mississippi (common).

Jacksonian (Zeuglodon zone): South side of Suck Creek, Clarke County, Mississippi (rare).

*Cotypes.*—Cat. No. 63841, U.S.N.M.

### OTIONELLA CAVA, new species.

Plate 21, figs. 8–14.

*Description.*—The zoarium is orbicular. On the outer surface the zooecia are arranged in regular quincunx lines. They are hexagonal, a little elongated, somewhat indistinct, confluent through the union of their mural rims; the mural rim is quite uniformly developed, thick, somewhat enlarged at the base. The opesium is elliptical, elongated, entire. The vibraculum is very large, twice as long as the zooecia, and is interzooecial, unsymmetrical and auriculated; its projecting lip is small. On the inner side the radial ribs are *hollow* and not calcified; the zooecial walls are pierced everywhere with small hydrostatic tuberosities.

*Measurements.*—Opesium $\left\{\begin{array}{l}ho=0.26\text{ mm.}\\ lo=0.18\text{ mm.}\end{array}\right.$ Zooecium $\left\{\begin{array}{l}Lz=0.35\text{ mm.}\\ lz=0.24\text{ mm.}\end{array}\right.$

Vibraculum $\left\{\begin{array}{l}Lv=0.65\text{ mm.}\\ lv=0.26\text{ mm.}\end{array}\right.$

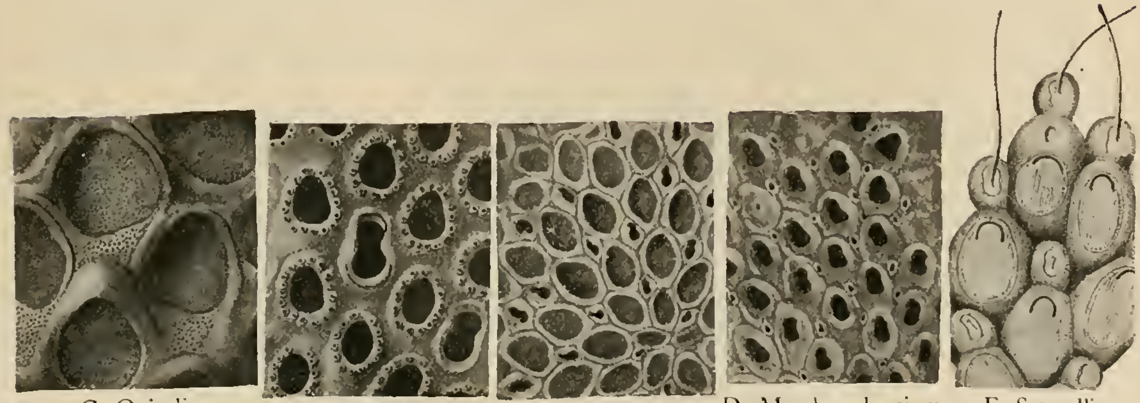
*Affinities.*—The hydrostatic system of this species is strongly developed and is quite analogous to that of *Lunularia distans* Lonsdale, 1845. The external surface of the ribs presents no sign of calcification. It is probable, however, that the ectocyst is not the only external membrane and that a chitinous cryptocyst replaced the calcified deposit which is wanting here. The zooecia appear thus to be both polypidian and hydrostatic.

On the inner side of the zoarium a fine white mealy powder refills the ribs, but this species is easily distinguished from *Otionella tuberosa* and from *O. perforata* by its gigantic vibracula and by the entire absence of the opesial collar.

*Occurrence.*—Middle Jacksonian: 3¼ miles south of Perry, Georgia (common); Baldock, Barnwell County, South Carolina (common).

Jacksonian (Zeuglodon zone): South side of Suck Creek, Clarke County, Mississippi (rare); Shubuta, Mississippi (rare).

*Cotypes.*—Cat. No. 63876, U.S.N.M.



C. Ogivalina B. Hincksina A. Vibracellina D. Membrendoecium E. Setosellina

FIG. 27.—Genera of Membraniporae with endozooecial ovicell.

A. *Vibracellina capillaria* Canu and Bassler, 1917, × 20. Claibornian, Caldwell County, Texas.

B. *Hincksina megavicularia* Canu and Bassler ,1917, × 20. Middle Jacksonian, Wilmington, North Carolina.

C. *Ogivalina eximipora* Canu and Bassler, 1917, × 20. Middle Jacksonian, Rich Hill, Crawford County, Georgia.

D. *Membrendoecium rectum*, new species, Vicksburgian, Byram, Mississippi.

E. *Setosellina roulei* Calvet, 1907, × 25. Recent.

### SECTION II. MEMBRANIPORAE WITH ENDOZOOECIAL OVICELL.

We have recognized four genera of Membranipores provided with an endozooecial ovicell, a structure which distinguishes them from genera of the first section quite as clearly as from those which have a hyperstomial ovicell. Furthermore, these four genera do not appear to belong even to the same family.

*Hincksina* according to Norman is a member of the Flustridae.

*Vibracellina* may perhaps belong to the Lunulariidae.

*Ogivalina* may be referred to the Onychocellidae.

*Membrendoecium* may perhaps belong to the Farciminariidae.

In the present state of bryozoology, generic grouping in distinct families quite frequently is necessarily artificial, arbitrary, and problematic, since we lack anatomical and larval data in most cases. It is better therefore to maintain these four genera in the present place rather than to introduce them doubtfully into the recent families mentioned above.

### Genus VIBRACELLINA Canu and Bassler, 1917.

1917. *Vibracellina* Canu and Bassler, Synopsis of American Early Tertiary Cheilostome Bryozoa, Bulletin 96, United States National Museum, p. 14.

Endozooecial ovicell. Auriform vibracula. No cryptocyst. No dietellae.

*Genotype.—Vibracellina capillaria* Canu and Bassler, 1917.

With the exception of *Cupuladria* we know three species of Membranipores having auriform vibracula. These are *Vibracella trapezoidea* Reuss, 1844, very well described by Waters,[1] who has created for it the genus *Vibracella; Pyripora confluens* Canu, 1907 (not Reuss, 1844), which is probably the type of a new genus and *Vibracellina capillaria*, Canu and Bassler, 1917.

In 1890 Kirkpatrick figured an incrusting species *Membranipora hastilis* from the China Sea, of which he wrote: "Placed transversely at the head of each zooecium are ear-shaped vibracular cells, toothed on one margin, with a vibraculum shaped like a double-edged spear." Some months later he declared he was mistaken and that his *Membranipora hastilis* was the same as *Membranipora coronata* Hincks. We think that he has been misled in the place occupied by the avicularium. That of *Membranipora coronata* is triangular and not auriform. The two species appear to us distinct and *M. hastilis* might be of the type of our genus *Vibracellina*.

### VIBRACELLINA CAPILLARIA Canu and Bassler, 1917.

Plate 16, fig. 16.

1917. *Vibracellina capillaria* Canu and Bassler, Synopsis of American Early Tertiary Bryozoa, Bulletin 96, United States National Museum, p. 14; pl. 1, fig. 5.

*Description.*—The zoarium incrusts small shells. The zooecia are elongate, distinct, oval, with a very small gymnocyst; the mural rim is convex, salient, very thin, almost *capillary*. The opesium is oval, entire. The vibraculum is interzooecial, unsymmetrical; its opesium is oblique and bounded by two lips of which the upper one is convex and sinuous. The ovicell is a distal convexity.

*Affinities.*—At the center of the figured zoarium may be noted two smaller zooecia almost equal; which of these is the ancestrula can not be discerned. It is also to be noted that, excepting these, the zooecia assume their normal size almost immediately. The absence of the cryptocyst and the almost complete absence of the gymnocyst will distinguish this species easily from *Pyripora confluens* Canu, 1907 (not Reuss, 1844).

*Occurrence.*—Claibornian (Cook Mountain formation): Moseleys Ferry, Caldwell County, Texas (rare).

*Holotype.*—Cat. No. 62572, U.S.N.M.

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[1] Waters, North Italian Bryozoa, Quarterly Journal Geological Society, London, vol. 47, p. 10, pl. 1 fig. 23.

### Genus SETOSELLINA Calvet, 1906.

1906. *Setosellina* Calvet, Note préliminaire sur les Bryozoaires recueillis par les expeditions du *Travailleur* (1881–82) et du *Talisman* (1883), Bulletin Museum Histoire Naturelle, p. 157.

The original description is as follows:

> Zooecies s'irradiant plus ou moins régulierèment autour de l'oozoide, séparées entre elles, dans les séries radiaires, par des vibraculaires. Frontale zoeciale en grande partie mémbraneuse, de forme ovale, à orifice zoeciale semicirculaire, dont le bord convexe correspond au bord supérieur de l'area, fermé par un opercule à bord convexe chitineux. Vibraculaires arrondis à area membraneuse oblongue, dirigée suivant l'axe longitudinal de la zooecie.

*Genotype.*—*Setosellina roulei* Calvet, 1907.

*Range.*—Priabonian-Recent.

This genus differs from *Vibracellina* Canu and Bassler, 1917, only in the arrangement of the vibracula. Calvet says that the genotype did not have an ovicell. Nevertheless there are two ovicells drawn on his figure.

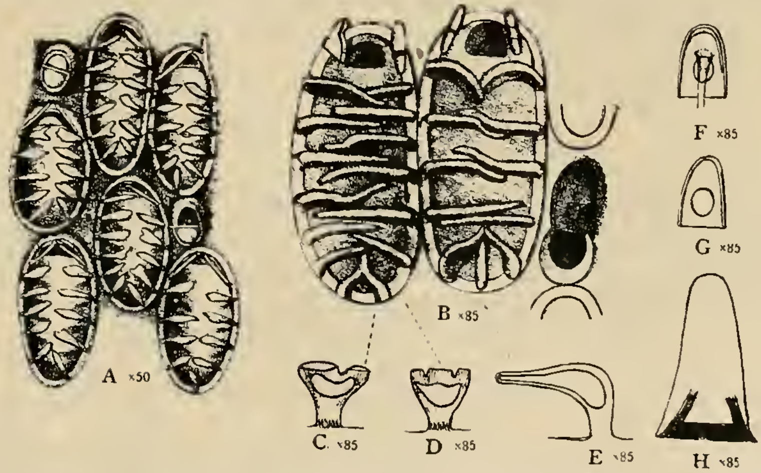

Fig. 28.—Genus *Hincksina* Norman, 1903.

A. *Hincksina flustroides* Hincks, 1880. Zooecia, × 50. (After Hincks, 1880.)

B–F. *Hincksina sceletos* Busk, 1858. B. Zooecia, × 85. C, D. Spinous plates by the side of the oral aperture, × 85. E. Frontal spine seen from the side, × 85. F. Mandible of the avicularium, × 85.

G. *Hincksina flustroides* Hincks, 1880. Avicularian mandible, × 85.

H. *Hincksina pyrula* Hincks, 1881. Avicularian mandible, × 85. (B–H after Waters, 1898.)

### Genus HINCKSINA Norman, 1903.

1903. *Hincksina* Norman, Natural History of East Finmark, Annals and Magazine Natural History, ser. 7, vol. 11, p. 585.

Zooecia incrusting, having the entire area membranous, the margin surmounted by numerous spines. Ovicell small, short, and little raised. Avicularia occupying distinct cells sparingly scattered among the zooecia, oval, with semicircular mandible. No dietellae. (Norman.)

*Genotype.*—*Membranipora flustroides* Hincks, 1880.

*Range.*—Jacksonian-Recent.

This is in part the *Membranipora corbula* group of Waters. The recent species belonging to the genus are as follows:

*Hincksina* (*Membranipora*) *flustroides* Hincks, 1880.
*Hincksina* (*Membranipora*) *pyrula* Hincks, 1881.
*Hincksina* (*Membranipora*) *maderensis* Waters, 1898.
*Hincksina* (*Membranipora*) *sceletos* Busk, 1858.
*Hincksina* (*Membranipora*) *minuscula* Hincks, 1882.
*Hincksina* (*Membranipora*) *defensa* Kirkpatrick, 1888.
*Hincksina* (*Membranipora*) *corniculifera* Hincks, 1882.
*Hincksina* (*Membranipora*) *inarmata* Hincks, 1881.

In this genus opposite spines may be able to unite and form a frontal analogous to that in the Costulidae, but this is not a general phenomenon, as it occurs only in very rare zooecia.

The species of *Hincksina* which we have distinguished may be separated into two groups. Those of the first section have small spines and avicularia little differentiated, while those of the second section are more typical.

## DIVISION I. AVICULARIA LITTLE DIFFERENTIATED.

### HINCKSINA REPTANS, new species.

Plate 22, figs. 1–3.

*Description.*—The zoarium incrusts small pebbles and bryozoa. The zooecia are elongated, elliptical, distinct; the mural rim is thin, salient, rounded, almost equal throughout, bearing with some irregularity from six to eight lateral and two distal spines. The opesium is large, entire, elliptical or irregular. The ovicells are very small and are manifested only as small distal convexities.

*Measurements.*—Opesia $\begin{cases} ho=0.30\text{–}0.32 \text{ mm.} \\ lo=0.20\text{–}0.22 \text{ mm.} \end{cases}$ Zooecia $\begin{cases} Lz=0.45\text{–}0.50 \text{ mm.} \\ lz=0.27\text{–}0.30 \text{ mm.} \end{cases}$

*Variations.*—On all of our specimens the lateral spines are very imperfectly preserved, but the two distal spines are more constant. The mural rim is generally thin, but it may become a little broader (fig. 2). The gymnocyst is much reduced and generally absent. The primoserial zooecia are often modified avicularian zooecia little differentiated. Regenerated zooecia are rare.

*Affinities.*—This species differs from *Hincksina jacksonica* in its incrusting zoarium and its more visible spines.

It differs from *Hincksina smithi* in its mural rim, which is never enlarged at the base, in its larger micrometric dimensions, its smaller ovicell and in its more inconstant spines.

It differs from *Hincksina vicksburgica* in the absence of all proximal crenulation of the opesium.

Among the recent species it has the greatest affinity with *Membranipora pyrula* as figured by Hincks[1] in 1881, but the ovicells are totally different.

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[1] Annals and Magazine Natural History, ser. 5, vol. 8, 1881, p. 51.

*Occurrence.*—Middle Jacksonian: Wilmington, North Carolina (rare); Eutaw Springs, South Carolina (rare); Rich Hill, Crawford County, Georgia (common): 18 miles west of Wrightsville, Jackson County, Georgia (very rare).

Upper Jacksonian (Ocala limestone): 1½ miles above Bainbridge, Georgia.

*Cotypes.*—Cat. No. 63878, U.S.N.M.

### HINCKSINA SMITHI, new species.

Plate 21, figs. 15–17.

*Description.*—The zoarium incrusts pebbles. The zooecia are elliptical, distinct, and may or may not have a gymnocyst; the mural rim is thin, salient, convex, ornamented with 8 to 10 spines. The opesium is elliptical and very slightly crenulated. The endozooecial ovicell is a quite visible convexity.

*Measurements.*—Opesia $\begin{cases} ho=0.30 \text{ mm.} \\ lo=0.14\text{–}0.17 \text{ mm.} \end{cases}$ Zooecia $\begin{cases} Lz=0.40\text{–}0.45 \text{ mm.} \\ lz=0.22\text{–}0.25 \text{ mm.} \end{cases}$

*Affinities.*—The mural rim is sometimes enlarged a little at the base as in *Hincksina ocalensis*, but the dimensions are much smaller and the spines more numerous. These same small dimensions and its very slightly crenulated opesium will distinguish it from *Hincksina reptans.*

*Hincksina smithi* differs from the recent *H. maderensis* Waters, 1898, in the absence of the five peculiar distal spines and in its small ovicell.

We dedicate this elegant species to Dr. Eugene A. Smith, State geologist of Alabama, who has been ever ready to further our researches with material from his State.

*Occurrence.*—Middle Jacksonian: Eutaw Springs, South Carolina (very rare).

*Holotype.*—Cat. No. 63877, U.S.N.M.

### HINCKSINA JACKSONICA Canu and Bassler, 1917.

Plate 22, figs. 4–9.

1917. *Hincksina jacksonica* CANU and BASSLER, Synopsis of American Early Tertiary Cheilostome Bryozoa, Bulletin 96, United States National Museum, p. 15, pl. 1, fig. 6.

*Description.*—The zoarium is free, bilamellar, easily divisible into two layers. The zooecia are elongated, distinct, elliptical, often with a small gymnocyst; the mural rim is convex, enlarged at the base, finely granulated. The opesium is terminal, elliptical, regular, very finely denticulated. The ovicell is endozooecial and little apparent; it appears as a small distal convexity. Avicularian zooecia are very rare.

*Measurements.*—Opesia $\begin{cases} ho=0.35\text{–}0.45 \text{ mm.} \\ lo=0.20\text{–}0.25 \text{ mm.} \end{cases}$ Zooecia $\begin{cases} Lz=0.45\text{–}0.65 \text{ mm.} \\ lz=0.35\text{–}0.40 \text{ mm.} \end{cases}$

The two lamellae forming the zoarium separate very easily, each preserving its own base.

*Variations.*—The zooecial length is quite variable; both long and short zooecia may occur (fig. 6). The avicularian zooecia or interzooecial avicularia are rather rare. They are generally primoserial (fig. 7); their opesium presents a lateral constriction but little accentuated.

This species is distinguished from the other species of *Hincksina* by the absence of visible spines and by its free zoarium. It is rather common at many localities of the Jacksonian, of which it appears to be a characteristic fossil.

*Occurrence.*—Middle Jacksonian: Rich Hill, 5½ miles southeast of Knoxville, Crawford County, Georgia (abundant); 12 miles southeast of Marshallville, Georgia (abundant); 3½ miles north of Grovania, Georgia (abundant); 18 miles west of Wrightsville, Georgia (abundant); 17 miles northeast of Hawkinsville, Georgia (abundant); near Georgia Kaolin Company Mine, Twiggs County, Georgia (abundant); Baldock, Barnwell County, South Carolina (common).

*Cotypes.*—Cat. No. 62573, U.S.N.M.

### HINCKSINA OCALENSIS, new species.

Plate 22, figs. 10–13.

*Description.*—The zoarium incrusts pebbles and shells. The zooecia are elongated, elliptical, and distinct. The mural rim is salient, granulose, convex, very thin at the top, enlarged and crenulated at the base, ornamented with spines of which the distal two are the more constant. The opesium is elliptical, almost entire laterally and crenulated proximally. The endozooecial ovicell is an indistinct convexity. The ancestrula is an ordinary zooecium, but smaller and very spinous.

*Measurements.*—Opesia $\begin{cases} ho=0.40\text{–}0.45\text{ mm} \\ lo=0.25\text{–}0.27\text{ mm.} \end{cases}$ Zooecia $\begin{cases} Lz=0.55\text{ mm.} \\ lz=0.32\text{–}0.35\text{ mm.} \end{cases}$

*Variations.*—As always the zooecia are smaller in the vicinity of the ancestrula, so our measurements are invariably taken far from this zooecium. The mural rim is much enlarged (fig. 12), but it always preserves its granular ornamentation and crenulation. As shown in figure 13, perforated zooecia with a large circular aperture have been noted.

*Affinities.*—The crenulation of the proximal part of the opesium is very characteristic and clearly distinguishes this species from all the preceding ones, and notably from *Hincksina jacksonica*, with which it might be confounded on account of its micrometric dimensions.

*Hincksina ocalensis* is nearest the recent *H. maderensis* Waters, 1898, but it has neither the large ovicell nor the five distal spines of that species.

We have observed this form at numerous localities in the Ocala limestone, and we believe it characteristic of this stage.

*Occurrence.*—Upper Jacksonian (Ocala limestone): 7 miles above Bainbridge, Georgia; 1½ miles above Bainbridge, Georgia; near Bainbridge, on the Flint River, Georgia; Chipola River, east of Marianna, Jackson County, Florida.

Vicksburgian (Byram marl): Byram, Mississippi (identification very doubtful).

*Cotypes.*—Cat. Nos. 63879, 63880, U.S.N.M.

### DIVISION II. WITH INTERZOOECIAL AVICULARIA DIFFERENTIATED.

The species of this section are as beautiful as they are well characterized. Their avicularia when present are similar in every respect to those of the recent species, such as *Hincksina pyrula*, *H. flustroides*, *H. sceletos*, etc., of which we have figured the mandibles. They are, however, without a pivot. One must not confound the species of this genus with those of the genus *Ornatella* Canu, 1900, in which the ovicells are hyperstomial.

### **HINCKSINA ELEGANS**, new species.

Plate 80, figs. 12–15.

*Description.*—The zoarium is unilamellate, creeping over algae. The zooecia are elongate, distinct, elliptical, provided with a gymnocyst; the mural rim is thicker in the proximal part below, finely granulated, adorned on its summit with a crown of large granules or of hollow spines; the two distal spines are larger, constant, and symmetrical. The opesium is elliptical and entire. The ovicell is a small distal convexity, smooth and indistinct; the border of the opesium is thick in the ovicelled zooecia.

*Measurements.*—Opesia $\begin{cases} ho=0.32\text{–}0.37 \text{ mm.} \\ lo=0.18\text{–}0.20 \text{ mm.} \end{cases}$ Zooecia $\begin{cases} Lz=0.45\text{–}0.47 \text{ mm.} \\ lz=0.32\text{–}0.35 \text{ mm.} \end{cases}$

*Affinities.*—Of this elegant species we possess unfortunately only the three figured specimens. The adornment of its mural rim is a small masterpiece of sculpturing which could well serve as model for the decorator. The little granules must be the traces of small hollow spines attenuated in the process of fossilization. The zooecia with ovicells have also the aspect of regenerated zooecia. It may be, therefore, that the female polypide succeeds the male in total regeneration.

This species differs from *Hincksina costulifera* in the presence of its two distal spines, which are larger than the areal spines, and in the opesial thickening of the ovicelled zooecia.

*Occurrence.*—Vicksburgian ("Chimney rock" of Marianna limestone): 1 mile north of Monroeville, Alabama (very rare).

*Cotypes.*—Cat. No. 64232, U.S.N.M.

### **HINCKSINA PARVAVICULARIA**, new species.

Plate 22, figs. 14, 15.

*Description.*—The zoarium is incrusting shells. The zooecia are large, elongated, distinct, pyriform or elliptical, with or without gymnocyst; the mural rim is prominent, convex, ornamented with sixteen large hollow spines. The opesium is elliptical, entire. The interzooecial avicularium is relatively *small* and unsymmetrical.

*Measurements.*—Opesia $\begin{cases} ho=0.40\text{–}0.45 \text{ mm.} \\ lo=0.25\text{–}0.30 \text{ mm.} \end{cases}$ Zooecia $\begin{cases} Lz=0.60\text{–}0.70 \text{ mm.} \\ lz=0.40\text{–}0.45 \text{ mm.} \end{cases}$

Avicularia = 0.33–0.45 mm.

*Affinities.*—This species differs from *Hincksina flustroides* Hincks, 1880, in its larger spines, its thicker mural rim, and its less symmetrical avicularia. The smaller size of these last distinguish it from *H. megavicularia* in which the avicularia are as large as the zooecia proper.

*Occurrence.*—Middle Jacksonian (Castle Hayne limestone): Wilmington, North Carolina (rare).

*Cotypes.*—Cat. No. 63881, U.S.N.M.

### HINCKSINA MEGAVICULARIA Canu and Bassler, 1917.

Plate 23, fig. 1.

1917. *Hincksina megavicularia* Canu and Bassler. Synopsis of American Early Tertiary Bryozoa, Bulletin 96, United States National Museum, p. 16, pl. 1, fig. 7.

*Description.*—The zoarium incrusts other bryozoa. The zooecia are large, distinct, elongated, pyriform, and have a gymnocyst; the mural rim is convex, salient, provided with 14 to 20 large, hollow spines. The opesium is terminal, elliptical, or somewhat pyriform, entire; the interzooecial avicularium is large, symmetrical, and has a gymnocyst; its opesium is constricted laterally, probably at the place where the pivot ought to be.

*Measurements.*—Opesia $\begin{cases} ho=0.30\text{–}0.35 \text{ mm.} \\ lo=0.25 \text{ mm.} \end{cases}$ Zooecia $\begin{cases} Lz=0.60\text{–}0.70 \text{ mm.} \\ lz=0.40 \text{ mm.} \end{cases}$

Length of avicularia=0.60–0.65 mm.

*Affinities.*—On account of its large avicularia this species differs considerably from *Hincksina parvavicularia*, but it approaches the recent *H. pyrula* Hincks, 1881. It differs, nevertheless, in its larger number of spines; unfortunately we are unable to compare the ovicells.

The specimen figured is very instructive. On a zooecium can be seen the coalescing of opposite spines, giving an aspect like the frontal of *Membraniporella*. Many zooecia are regenerated; in one case a normal zooecium succeeds a normal zooecium and a double row of spines results; in another case an avicularium replaces a zooecium; in a third an avicularium again replaces a zooecium, but in a totally inverted position.

*Occurrence.*—Middle Jacksonian (Castle Hayne limestone): Wilmington, North Carolina (very rare).

*Holotype.*—Cat. No. 62574, U.S.N.M.

### HINCKSINA COSTULIFERA, new species.

Plate 23, figs. 2–5.

*Description.*—The zoarium incrusts other bryozoa or creeps over algae. The zooecia are elongated, distinct, elliptical or pyriform with or without a gymnocyst; the mural rim is convex, salient, ornamented with 13 to 15 areal spines and 2 oral spines a little larger. The opesium is elliptical, entire. The endozooecial ovicell is a salient convexity. No interzooecial avicularia. The ancestrula is a small ordinary zooecium.

*Measurements.*—Opesia $\begin{cases} ho=0.34\text{–}0.40 \text{ mm.} \\ lo=0.20 \text{ mm.} \end{cases}$ Zooecia $\begin{cases} Lz=0.48\text{–}0.50 \text{ mm.} \\ lz=0.28\text{–}0.32 \text{ mm.} \end{cases}$

*Variations.*—The distal part of the mural rim comprised between the two oral spines presents three important variations. Sometimes it is a thin and spineless portion of the rim, again it supports two spines smaller than the others, and finally very often it contains a small canal of unknown function.

The coalescence of opposite spines is very frequent and there are small portons of the zoarium bearing *costulae* which might be classified as *Membraniporella*. Typical *Membraniporella*, however, never presents when broken the aspect of the normal zooecia of this species. It would be very interesting to compare the microstructure of these spines with those of the costules of *Membraniporella*, but the very limited number of specimens found has not permitted this.

The specimens from the Vicksburgian near Monroeville, Alabama, which incrusted algae and in which the zooecia are hexagonal constitute perhaps a different species or at least a variety; but we have found only two specimens thus far.

*Affinities.*—The small micrometric dimensions and the absence of interzooecial avicularia distinguish this species clearly from *Hincksina parvavicularia* and *H. megavicularia*. The ovicell is extremely rare.

*Occurrence.*—Middle Jacksonian: Wilmington, North Carolina (common); near Lenuds Ferry, South Carolina (rare).

Vicksburgian ("Chimney rock" of Marianna limestone): One mile north of Monroeville, Alabama (a variety or closely related new species).

*Cotypes.*—Cat. Nos. 63882, 63883, U.S.N.M.

KEY TO SPECIES OF HINCKSINA.

| | | |
|---|---|---|
| 1. | Large spines having power to unite | 2 |
| | Spines small or absent | 4 |
| 2. | Small interzooecial avicularia (L 0.40 mm.) | *H. parvavicularia.* |
| | Large interzooecial avicularia (L 0.60 mm.) | *H. megavicularia.* |
| | No interzooecial avicularia | 3 |
| 3. | All of the spines equal | *H. costulifera.* |
| | Two distal spines larger | *H. elegans.* |
| 4. | Spines absent; zoarium bilamellar | *H. jacksonica.* |
| | Spines present; zoarium incrusting | 5 |
| 5. | Mural rim enlarged at the base, opesium crenulated proximally | *H. ocalensis.* |
| | Opesium not crenulated | 6 |
| 6. | Zooecia small ($Lz$=0.40–0.45 mm.); large ovicells | *H. smithi.* |
| | Zooecia large ($Lz$=0.45–0.50 mm.); small ovicells | *H. reptans.* |

## Genus OGIVALINA Canu and Bassler, 1917.

1917. *Ogivalina* Canu and Bassler, Synopsis of American Early Tertiary Cheilostome Bryozoa, Bulletin 96, United States National Museum, p. 16.

Endozooecial ovicell. Granular cryptocyst. No dietellae. No spines.

*Genotype.*—*Ogivalina eximipora* Canu and Bassler, 1917. Jacksonian.

The zooecia have the usual aspect of those in the family Onychocellidae, but the interzooecial onychocellarium is replaced by an interopesial avicularium.

### OGIVALINA EXIMIPORA Canu and Bassler, 1917.

Plate 23, figs. 6, 7.

1917. *Ogivalina eximipora* CANU and BASSLER, 1917, Synopsis of American Early Tertiary Cheilostome Bryozoa, Bulletin 96, United States National Museum, p. 17, pl. 2, fig. 1.

*Description.*—The zoarium is composed of one or more lamellae and incrusts pebbles or creeps over algae. The zooecia are large, elongated, ogival, distinct, separated by a thread-like ridge; the mural rim is indistinct, thin, flat, smooth, enlarged at the base into a concave, granular, irregular cryptocyst. The opesium is oval, entire, unsymmetrical in its proximal part. The endozooecial ovicell is a distal convexity, quite apparent. The avicularium is interopesial, triangular, relatively small, and without pivot.

*Measurements.*—Opesia $\begin{cases} ho=0.75\text{–}0.80\text{ mm.} \\ lo=0.55\text{–}0.70\text{ mm.} \end{cases}$ Zooecia $\begin{cases} Lz=1.20\text{–}1.25\text{ mm.} \\ lz=0.80\text{ mm.} \end{cases}$

Length of avicularium=0.40 mm.

*Variations.*—The opesium has little regularity of shape on account of the very irregular development of the cryptocyst itself. Although the latter is generally plainly visible, there are nevertheless zooecia which are almost devoid of the cryptocyst. But the most important variation is the unsymmetrical shape of its distal border, a lack of symmetry characteristic of the genus *Onychocella.* We know that this phenomenon is occasioned by the obliquity of the polypide in the zooecium by reason of the attachment of the retractor muscles in one of the proximal corners of the said zooecium. This anatomical feature appears to us to have more importance than the absence of the onychocellarium.

*Occurrence.*—Middle Jacksonian: Wilmington, North Carolina (rare); near Lenuds Ferry, South Carolina (rare); Eutaw Springs, South Carolina (very rare); Rich Hill, Crawford County, Georgia (very rare).

*Cotypes.*—Cat. Nos. 63884, 62875, U.S.N.M.

### OGIVALINA ELONGATA, new species.

Plate 23, fig. 8.

*Description.*—The zoarium incrusts other bryozoa. The zooecia are *elongated,* distinct, elliptical, slightly narrowed in the rear: the mural rim is thin, smooth, convex, salient, and encompasses the entire zooecium. The opesium is elliptical; the cryptocyst is flat, distinct from the mural rim, granular on the surface, and finely denticulated on its distal edge. The ovicell is a small distal swelling.

*Measurements.*—Opesia $\begin{cases} ho=0.35\text{ mm.} \\ lo=0.22\text{–}0.25\text{ mm.} \end{cases}$ Zooecia $\begin{cases} Lz=0.55\text{–}0.50\text{ mm.} \\ lz=0.35\text{–}0.45\text{ mm.} \end{cases}$

*Variations.*—The feature which is very characteristic in this species is the more distinct separation of the mural rim and cryptocyst than in *Ogivalina eximipora,* where it is the mural rim itself which is enlarged into the cryptocyst. Another important difference is in the symmetry of the opesium, which is one of the characters of the Membranipore group and not of the Onychocellidae. The dorsal olocyst is very thin and easily worn away, allowing the substratum to appear. We have observed some cases of total regeneration and deformed zooecia are not rare.

*Affinities.*—It may be that this species ought to be classed in *Hincksina;* however, the great development of the cryptocyst and the entire absence of avicularia will not allow us to place it there. This is a problem which can find its solution only in the study of an identical or closely allied recent species.

The zooecia resemble those of *Amphiblestrum perfragile* MacGillivray, 1868, figured by Ortman in 1890. The present species differs in its nonbilamellar zoarium and in the absence of a large interzooecial avicularium. MacGillivray's species may belong to a new genus.

*Occurrence.*—Middle Jacksonian: Near Lenuds Ferry, South Carolina (common); Wilmington, North Carolina (very rare); Eutaw Springs, South Carolina (rare).

*Holotype.*—Cat. No. 63885, U. S. N. M.

### OGIVALINA ELONGATA, var. MINOR, new variety.

Plate 23, figs. 9, 10

This variety is well founded, for no intermediate specimens have been noticed. However, it can not be considered a smaller distinct species, for it occurs at the same localities as the species itself.

*Measurements.*—Opesia $\left\{\begin{array}{l} ho=0.25\text{–}0.50\text{ mm.}\\ lo=0.17\text{–}0.20\text{ mm.}\end{array}\right.$ Zooecia $\left\{\begin{array}{l} Lz=0.40\text{–}0.43\text{ mm.}\\ lz=0.22\text{–}0.26\text{ mm.}\end{array}\right.$

*Occurrence.*—Middle Jacksonian: Wilmington, North Carolina (rare); near Lenuds Ferry, South Carolina (rare); Eutaw Springs, South Carolina (rare).

Lower Jacksonian (Moodys marl): Jackson, Mississippi (rare).

*Cotypes.*—Cat. No. 63886, U.S.N.M.

### Genus MEMBRENDOECIUM Canu and Bassler, 1917.

1917. *Membrendoecium* CANU and BASSLER, Synopsis of American Early Tertiary Cheilostome Bryozoa, Bulletin 96, United States National Museum, p. 17.

Ovicell endozooecial. Small simple interopesial avicularia. Dietellae present. No spines.

*Genotype.*—*Amphiblestrum papillatum* Busk, 1884.

*Range.*—Midwayan—Recent.

In *Membrendoecium* we have a very natural genus with exact characters. The recent species *Amphiblestrum papillatum* is closely related to our fossil forms, but unfortunately this species is very rare and its structure is imperfectly known. Its avicularia have much the aspect of our species, and Busk writes of it "Small avicularia having a triangular mandible on small papillary eminences seated in the angular interzooecial spaces."

In its exterior aspect this genus recalls *Pyriporella* Canu, 1911, but the latter has hyperstomial ovicells. The structures which Canu has identified as vibracula are, perhaps, small, simple avicularia without pivot or axis analogous to those in *Amphiblestrum papillatum*. On the fossils on account of their simplicity it is sometimes almost impossible to distinguish an avicularium from a vibraculum. It is evident that the affinities of *Membrendoecium* are with the *Farciminariidae*.

### MEMBRENDOECIUM TRANSVERSUM, new species.

Plate 3, figs. 11–13.

*Description.*—The zoarium incrusts shells. The zooecia are elongated, distinct, oval; the mural rim is prominent, flat, oblique, wrinkled, enlarged at the base. The opesium is oval, the narrow end in front, entire or crenulated. The endozooecial ovicell is a large, smooth, distal convexity. The avicularium placed in front of each zooecium is small, triangular, pointed, with or without pivot, with its axis *transverse* with respect to that of the zooecium.

*Measurements.*—Opesia $\begin{cases} ho=0.27\text{–}0.30 \text{ mm.} \\ lo=0.20\text{–}0.22 \text{ mm,} \end{cases}$ Zooecia $\begin{cases} Lz=0.45\text{–}0.50 \text{ mm.} \\ lz=0.30\text{–}0.35 \text{ mm.} \end{cases}$

*Variations.*—On account of its transverse avicularium this species forms a rather divergent type in the genus; but we have not considered it advisable to create a special genus for it, because of the very restricted number of our specimens. In the neighborhood of the ancestrula there are regenerated zooecia and also closed zooecia perforated with a circular orifice. The gymnocyst is rarely developed. The most striking variation observed in the species is the strong denticulation of the opesium on a specimen from Fort Gaines, Georgia.

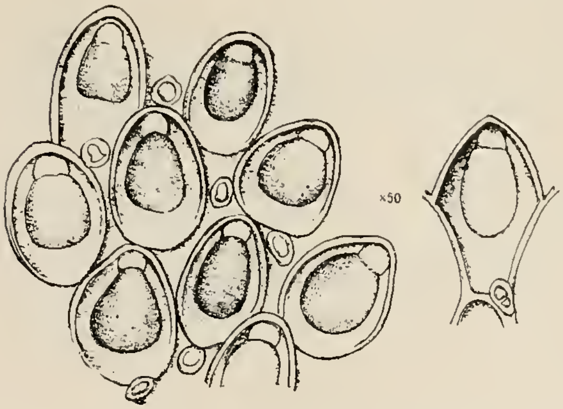

FIG. 29.—Genus *Membrendoecium* Canu and Bassler, 1917. The genotype *Membrendoecium papillatum* Busk, 1884, × 50. (After Busk.)

*Occurrence.*—Midwayan (Clayton limestone): Mabelvale, near Little Rock, Arkansas (rare); 1 mile west of Fort Gaines, Georgia (rare).

*Cotypes.*—Cat. No. 63791, U.S.N.M.

### MEMBRENDOECIUM DUPLEX, new species.

Plate 24, figs. 1–6.

The zoarium incrusts shells (*Ostrea*). The zooecia are elongated, distinct, or confluent, oval; the mural rims are distinct, thin, salient, curved, granulated, not enlarged at the base, and without dietallae; the mural rims when confluent are thick, convex, granulated, with five distal dietellae. The opesium is oval or elliptical, very finely denticulated. The ovicell is a small, smooth, distal convexity. The avicularia are interopesial, very small, elliptical, little raised. The ancestrula is very small.

*Measurements.*—Opesia $\left\{\begin{array}{l} ho=0.24\text{–}0.30\text{ mm.} \\ lo=0.16\text{–}0.18\text{ mm.}\end{array}\right.$ Zooecia $\left\{\begin{array}{l} Lz=0.40\text{ mm.} \\ lz=0.24\text{ mm.}\end{array}\right.$

*Variations.*—A remarkable phenomenon in this species is the *dimorphism* of the mural rim. On the same zoarium, without any apparent reason, there are mural rims thin and distinct, and others thick and confluent. The first are devoid of dietellae while the second have five of them. These small pore-chambers are not therefore indispensable to the life of all the zooecia of the same zoarium, and not even to the passage of the mesenchymatous fibers. The ancestrula is very small. Around it the zooecia have always a separate mural rim and are not always accompanied by avicularia. The same holds true on the zoarial margins. We have not observed regenerated zooecia.

*Affinities.*—This species differs from *Membrendoecium rectum* in its confluent mural rims not enlarged at the base and in its very inconspicuous avicularia. The specimen figured from Bainbridge, Georgia, is altered chemically, as are most of the specimens from this locality.

*Occurrence.*—Upper Jacksonian (Ocala limestone): Bainbridge, Georgia; Red Bluff, on Flint River, 7 miles above Bainbridge, Georgia (rare); west bank of Sepulga River, Escambia County, Alabama (rare); Chipola River, east of Marianna, Jackson County, Florida (rare).

Middle Jacksonian: Baldock, Barnwell County, South Carolina (rare); 18 miles west of Wrightsville, Johnson County, Georgia (very rare).

Lower Jacksonian (Moodys marl): Jackson, Mississippi (very rare).

*Cotypes.*—Cat. Nos. 63889–63892, U.S.N.M.

### MEMBRENDOECIUM LOWEI, new species.

Plate 81, fig. 1.

*Description.*—The zoarium incrusts small pebbles, from which it becomes easily detached. The zooecia are elongated, elliptical, distinct, or confluent: the mural rim is broad, flat, granulose. The opesium is elliptical or oval, the narrow end proximal. The ovicell is a very small, distal convexity. The avicularia are very indistinct and not prominent.

*Measurements.*—Opesia $\left\{\begin{array}{l} ho=0.20\text{ mm.} \\ lo=0.12\text{ mm.}\end{array}\right.$ Zooecia $\left\{\begin{array}{l} Lz=0.30\text{ mm.} \\ lz=0.20\text{–}0.22\text{ mm.}\end{array}\right.$

*Affinities.*—The mural rims are very often united, so that the boundary between the zooecia is little visible. It is impossible to say whether the avicularia are indeed present or if these are only interopesial cavities. If, therefore, our observation of the endozooecial ovicells should not be confirmed, it would be necessary to place this species under *Conopeum*.

*Membrendoecium lowei* differs from *M. duplex* in its smaller micrometric dimensions and in its inconspicuous avicularia.

We take pleasure in dedicating this species to Mr. E. N. Lowe, State geologist of Mississippi, who has spared no efforts in supplying us with material for study.

*Occurrence.*—Vicksburgian (Bryam marl): Vicksburg, Mississippi (rare).

*Holotype.*—Cat. No. 64233, U.S.N.M.

### MEMBRENDOECIUM RECTUM, new species.

Plate 13, figs. 1–8.

The zoarium incrusts other bryozoa and pebbles. The zooecia are elongate, distinct, oval; the mural rim is salient, smooth, a little widened on the margins, very much widened at the base, with five distal dietellae. The opesium is oval, entire. The ovicell is endozooecial and is a small, smooth, distal convexity. The avicularia are small, *straight*, salient, and elliptical. The ancestrula is a very small, closed zooecium.

*Measurements.*—Opesia $\left\{\begin{array}{l} ho=0.14\text{–}0.16\text{ mm.} \\ lo=0.10\text{ mm.} \end{array}\right.$ Zooecia $\left\{\begin{array}{l} Lz=0.32\text{–}0.40\text{ mm.} \\ lz=0.20\text{–}0.24\text{ mm.} \end{array}\right.$

*Variations.*—Specimens of this species assume a little different aspect according to their geologic horizon, although not enough to make it possible to establish true specific differences. Very frequently in the Clabornian and Jacksonian the zooecial length does not surpass 0.22–0.24 mm. However, these variations depend chiefly on the presence or absence of a small gymnocyst.

Around the ancestrula there is an important group of closed zooecia perforated with a circular pore and bearing distally, as is usual the imprint of the opercular valve, which we must therefore suppose to have been thickened on its edges. We have observed some regenerated zooecia with double mural rims.

*Affinities.*—This species differs from *Membrendoecium duplex* in the widening of the mural rim at the base and in that the zooecia do not become confluent. It differs from *M. pyriforme* in its smaller micrometer dimensions and the almost general absence of a gymnocyst.

*Occurrence.*—Lower Jacksonian: 3½ miles southeast of Shell Bluff post office, Georgia (rare).

Middle Jacksonian: Wilmington, North Carolina (very rare); 18 miles west of Wrightsville, Hawkins County, Georgia (rare); ½ mile southeast of Georgia Kaolin Company Mine, Twiggs County, Georgia (rare); 17 miles northeast of Hawkinsville, Georgia (rare).

Upper Jacksonian (Ocala limestone), Chipola River, east of Marianna, Jackson County, Florida (rare).

Vicksburgian (Byram marl): Byram, Misrissippi (common).

Vicksburgian ("Chimney rock" of Marianna limestone): One mile north of Monroeville, Alabama (common): near Claiborne, Monroe County, Alabama (rare).

Vicksburgian (Glendon member of Marianna limestone): West bank of Conecuh River, 1 mile below mouth of Sepulga River, Escambia County, Alabama (very rare).

*Cotypes.*—Cat. Nos. 63842, 63965, U.S.N.M.

### **MEMBRENDOECIUM PYRIFORME** Canu and Bassler, 1917.

Plate 23, figs. 11–14.

1917. *Membrendoecium pyriforme* CANU and BASSLER, Synopsis of American Early Tertiary Cheilostome Bryozoa, Bulletin 96, United States National Museum, p. 17, pl. 2, fig. 2.

The zoarium incrusts bryozoa or small shells. The zooecia are very elongate, *oval*, distinct, and have a gymnocyst; the mural rim is prominent, smooth, somewhat convex, enlarged on the margins, and much enlarged at the base. The opesium is oval, entire. The ovicell is endozooecial and is a small, smooth, distal convexity. The avicularia are very small, straight, salient, elliptical, often provided with a gymnocyst. The ancestrula is surrounded by closed zooecia in which the frontal is perforated by an orbicular pore.

*Measurements.*—Opesia $\begin{cases} ho=0.20\text{–}0.30 \text{ mm.} \\ lo=0.13\text{–}0.16 \text{ mm.} \end{cases}$

Zooecia $\begin{cases} Lz=0.40\text{–}0.50 \text{ mm.} \\ lz=0.24\text{–}0.30 \text{ mm.} \end{cases}$ (Omitting the gymnocyst.)

*Variations and affinities.*—The length of the gymnocyst is quite variable even on the same zoarium; therefore in the micrometric measurements it is preferable not to count the gymnocyst, for many of the zooecia are devoid of it. The reduction of the zooecial length is frequent in this species and affects the entire zoarium: it is rather a rare occurrence when some mechanical obstacle is not opposed to the free development of the zooecia.

This species is very closely related to *Amphiblestrum papillatum* of Australasia, depending on Busk's figures, which we reproduce on page 120. The micrometric measurements are identical. The avicularia appear a little larger and the ovicell is unknown.

*Membrendoecium pyriforme* differs from *M. rectum* in its much larger micrometric measurements and in the presence of the gymnocyst.

*Occurrence.*—Vicksburgian (Red Bluff clay): 7½ miles southwest from Bladen Springs, Alabama (very rare).

Vicksburgian (Marianna limestone): Murder Creek, east of Castlebury, Conecuh County, Alabama (very rare); Claiborne, Monroe County, Alabama (very rare); Salt Mountain, 5 miles south of Jackson, Alabama (common); deep well, Escambia County, Alabama (very rare).

Lower Jacksonian (Moodys marl): Jackson, Mississippi (very rare).

*Cotypes.*—Cat. Nos. 63887, 63888, U.S.N.M.

## SECTION 3. OVICELL HYPERSTOMIAL, ALWAYS CLOSED BY THE OPERCULUM.

It is not easy to recognize on a fossil form whether the opercular valve does or does not close the hyerstomial ovicell. After many dissections, which we have made on living species, we have recognized that generally ovicells of this kind leave a concave cicatrix above the mural rim, a part of which is thus concealed. There is evidently a great amount of uncertainty, but we can do nothing more with present knowledge. We would add that the different genera grouped in this section, although very natural in themselves, appear to belong to different families which the zoologists alone can determine.

### Genus PERIPOROSELLA Canu and Bassler, 1917.

1917. *Periporosella* Canu and Bassler, Synopsis of American Early Tertiary Cheilostome Bryozoa, Bulletin 96, United States National Museum, p. 18.

Each zooecium is surrounded by a special series of dietellae (12 to 16) communicating with two large septulae.

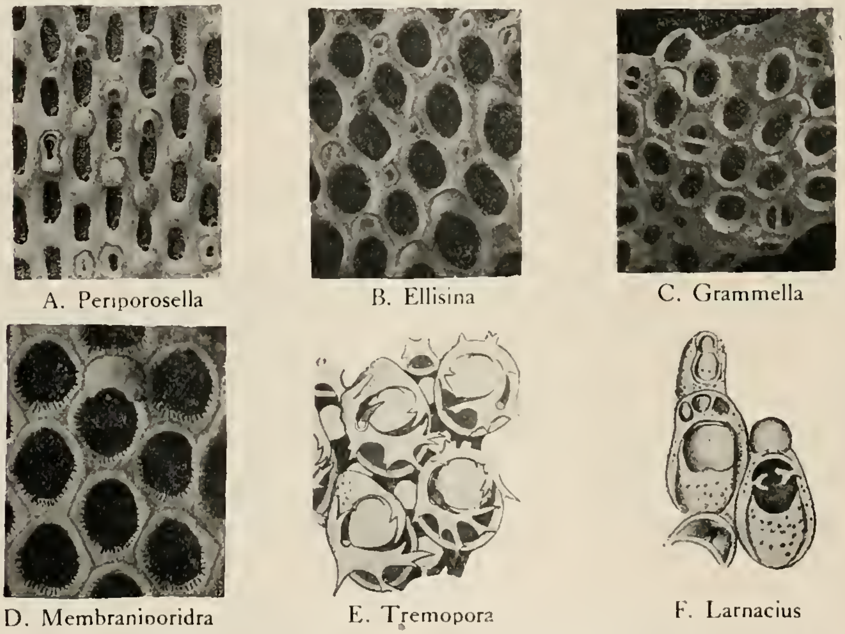
A. Periporosella
B. Ellisina
C. Grammella
D. Membraniporidra
E. Tremopora
F. Larnacius

Fig. 30.—Membraniporae with hyperstomial ovicells, always closed by the opercular valve.

A. *Periporosella tantilla* Canu and Bassler, 1917. × 20, Middle Jacksonian, Wilmington, North Carolina.

B. *Ellisina brevis*, new species, × 20, Middle Jacksonian, near Lenuds Ferry, South Carolina.

C. *Grammella pusilla*, new species, × 20, Vicksburgian, 1 mile north of Monroeville, Alabama.

D. *Membraniporidra trigemma*, new species, × 20, Middle Jacksonian, Wilmington, North Carolina.

E. *Tremopora dendracantha* Ortmann, 1890. Recent.

F. *Larnacius corniger* Busk, 1852. Recent.

*Genotype.—Periporosella tantilla* Canu and Bassler, 1917. Jacksonian.

In all the other genera of Membranipores provided with dietellae the latter occupy only the anterior half of the zooecium. In the genus *Periporosella* they are, on the contrary, arranged all about the zooecium as in the family Adeonidae. These dietellae are invisible externally, and they become apparent only in tangential sections of some depth.

### PERIPOROSELLA TANTILLA Canu and Bassler, 1917.

Plate 24, figs. 7–12.

1917. *Periporosella tantilla* Canu and Bassler, Synopsis American Early Tertiary Cheilostome Bryozoa, Bulletin 96, United States National Museum, p. 19, pl. 2, figs. 3, 4.

The zoarium is free, formed by two lamellae joined together and inseparable. The zooecia are generally indistinct, very elongated, rectangular; the mural rim is broad, flat, enlarged at the base. The opesium is elliptical, somewhat enlarged distally, and very finely denticulated. The ovicell is deep but placed above the large distal septula; it projects but little exteriorly. The avicularia are interzooecial, rare, elliptical, without pivot, but with two lateral denticles; numerous dietellae in each zooecium.

*Measurements.*—Opesia $\begin{cases} ho=0.30\text{–}0.40 \text{ mm.} \\ lo=0.11\text{–}0.19 \text{ mm.} \end{cases}$ Zooecia $\begin{cases} Lz=0.40\text{–}0.50 \text{ mm.} \\ lz=0.25 \text{ mm.} \end{cases}$

*Variations.*—In this species we have one of the most peculiar types of Membranipores. The dietellae arranged entirely around each zooecium (figs. 10, 11) are covered by an epithecal olocyst analogous to the olocyst of the mural rims in the Membranipores. These elements group themselves in a radial manner about the opesium (fig. 12).

Another interesting peculiarity is the mode of gemmation of the zooecia which are arranged in parallel linear series, and every new row appears invariably on one of the free edges of the zoarium.

The large distal septula opens in a dietella, which establishes communication with the succeeding zooecium, and its opening is often visible in the latter.

This type of structure is different from all others on account of its dietellae, its method of gemmation, its ovicell, and even its avicularia. It certainly belongs to a family which our present zoological knowledge will not yet permit us to suspect.

*Occurrence.*—Middle Jacksonian: Wilmington, North Carolina (common); near Lenuds Ferry, South Carolina (rare); Eutaw Springs, South Carolina (rare).

*Cotypes.*—Cat. No. 62577, U.S.N.M.

### Genus ELLISINA Norman, 1903.

1903. *Ellisina* Norman, Natural History of East Finmark, Annals and Magazine Natural History, ser. 7, vol. 11, p. 596.

The zooecia are furnished with avicularia, ovoid or triangular, situated on the hinder portion of the zooecium. The ovicell is well developed, typically with a flattened area on its front. In the type-species the pore-chambers (dietellae) are very large; one distal; the position of the remaining chambers is very unusual, the two front lateral pairs project outside the side walls; and the two posterior pairs are seen inside the side walls, which is the reverse of the usual rule. (Norman).

*Genotype.*—*Membranipora levata* Hincks, 1882.

*Range.*—Senonian-Recent.

This is the *Membranipora coronata* group of Waters, which he defined as follows: " Small avicularium above the zooecium; ovicells small, globular, or cucullate."

The opercular valve always closes the ovicell, but may open it either by elevation or depression for the escape of the larvae.

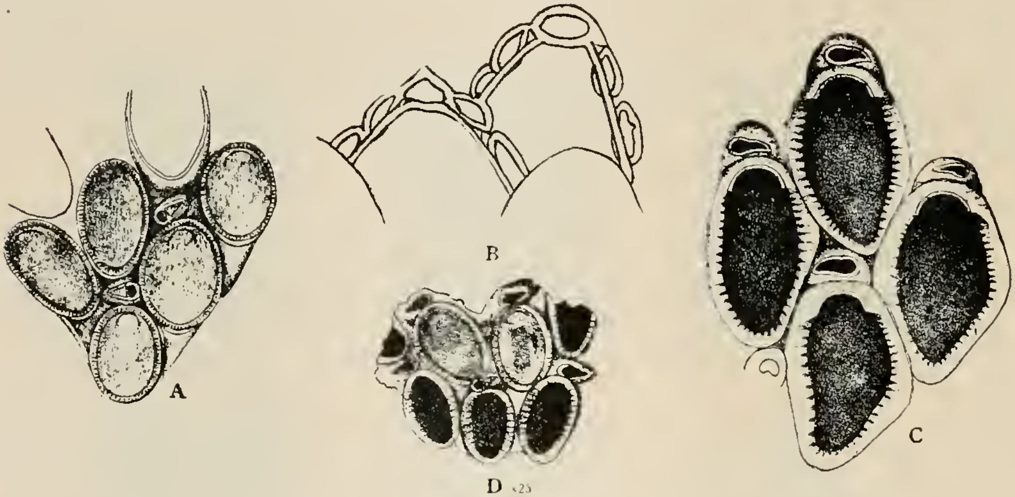

FIG. 31.—Genus *Ellisina* Norman, 1903.

A, B. *Ellisina levata* Hincks, 1882. A. Several zooecia magnified. (After Hincks, 1882.) B. Sketch showing dietellae. (After Norman, 1903.)

C. *Ellisina coronata* Hincks, 1881. Several zooecia. (After Hincks, 1881.)

D. *Ellisina incrustans* Waters, 1898. Zooecia, × 25. (After Waters, 1898.)

The recent species belonging to this genus are as follows:

*Ellisina* (*Membranipora*) *levata* Hincks, 1882.
*Ellisina* (*Membranipora*) *coronata* Hincks, 1881.
*Ellisina* (*Membranipora*) *albida* Hincks, 1880.
*Ellisina* (*Membranipora*) *minuscula* Hincks, 1882.
*Ellisina* (*Membranipora*) *incrustans* Waters, 1898.

The fossil species are:

*Ellisina* (*Membranipora*) *profunda* MacGillivray, 1894.
*Ellisina* (*Membranipora*) *rhomboidalis* D'Orbigny, 1852.
*Ellisina* (*Reptoflustrella*) *simplex* D'Orbigny, 1852.
*Ellisina* (*Reptoflustrella*) *ovalis* D'Orbigny, 1852.
*Ellisina* (*Membranipora*) *humaliata* Brydone, 1910.
*Ellisina* (*Escharinella*) *altimuralis* Ulrich and Bassler, 1907.
*Ellisina ? angusta*, Ulrich, 1901.
*Ellisina spiculosa* Ulrich, 1901.

### ELLISINA SPICULOSA Ulrich, 1901.

Plate 1, figs. 3–5.

1901. *Membranipora spiculosa* Ulrich, Maryland Geological Survey, Eocene, p. 212, pl. 9, figs. 3, 4.

*Description.*—"Zoarium adnate. Zooecia arranged in quincunx or irregularly, oblong, rounded and widest above, more or less produced below. Opesia large, normally ovate, the upper edge nicely rounded, the lower variable, taking up about half of the length of the zooecium. Rim thin, highest above, usually dying out before reaching lower extremity of zooecium. Front wall over lower half of zooecium, slightly depressed, covered with small granules or spines, those bordering the edge projecting sharply into the opesial opening. Ooecia numerous, cucullate, strongly elevated, often with a tubercle or point forming the summit. When a zooecium is without an ooecium its place is often occupied by an elevated avicularium of moderate size. The avicularia are very few in number, but when present similar to those found in *Reptoflustrella heteropora* Gabb and Horn. Length of zooecium 0.5 or 0.6 mm.; width, 0.25 to 0.30 mm. The specimen described shows a single cell differing from the rest in being closed, a convex cover, at the upper extremity of which a semi-circular impression is distinguishable, extending over the whole." (After Ulrich.)

The ovicell is certainly closed by the opercular valve.

*Occurrence.*—Lowest Eocene (Bryozoan bed at base of Aquia formation): Upper Marlboro, Maryland (rare).

### ELLISINA (?) ANGUSTA Ulrich, 1901.

Plate 1, figs. 6–10.

1901. *Membranipora angusta* Ulrich, Maryland Geological Survey, Eocene, p. 213, pl. 60, figs. 5, 6.

*Original description.*—"Among the material from Upper Marlboro there are several specimens of a delicate *Membranipora* that, on account of their imperfection and fragile nature, it may be risky to distinguish as a new species. However, as it is easily recognized and may prove useful in stratigraphic studies, the writer has ventured to name it as above. The zooecia are shallow, elongate, elliptical, hexagonal, or rhomboidal, and separated except in young stages by a thin tuberculated wall common to adjoining cells (that is, there is usually no depressed dividing line between the zooecia). The inner portion of the wall is much thicker than the outer, so that the mouths of the connecting pores, of which there are at least six on each side and one or two at each end, are clearly shown in a view of the front. Two specimens have cucullate ooecia and on all an occasional small oval or rounded and slightly raised avicularium may be noticed. The zooecia are about 0.4 mm. long and 0.2 mm. wide. *M. angusta* apparently belongs to the *M. lineata* group of Waters."

*Measurements.*—Opesia $\begin{cases} ho=0.30 \text{ mm.} \\ lo=0.16 \text{ mm.} \end{cases}$ Zooecia $\begin{cases} Lz=0.40\text{–}0.48 \text{ mm.} \\ lz=0.20\text{–}0.24 \text{ mm.} \end{cases}$

We have little to add to the description given by Ulrich. The specimens are very fragile, much altered, and do not lend themselves readily to dissection necessary in study. The ovicell is transverse and appears to be closed (?) by the opercular valve. The distal avicularium occurs frequently and is rather large, round, and without pivot.

The septulae are large, plainly visible, and do not appear to correspond to the number of dietellae. They are also extremely fragile. After rubbing away the surface only a large distal and a lateral pair have come to view. The lateral dietellae are perhaps divided into three portions corresponding to the three pairs of normal septulae. If this should be so, this species is incorrectly placed in the genus *Ellisina* and should be classed in *Cauloramphus* Norman, 1903. In the latter genus, however, according to its author, the ovicells are "very shallow and inconspicuous," which is not the case in the present species.

*Occurrence.*—Lowest Eocene (Bryozoan bed at base of Aquia formation): Upper Marlboro, Maryland (abundant).

*Plesiotypes.*—Cat. No. 63775, U.S.N.M.

### ELLISINA LAXA Canu and Bassler, 1917.

Plate 25, figs. 1, 2.

1917. *Ellisina laxa* Canu and Bassler, Synopsis of American Early Tertiary Cheilostome Bryozoa, Bulletin 96, United States National Museum, p. 19, pl. 2, fig. 7.

*Description.*—The zoarium incrusts pebbles and especially shells. The zooecia are large, distinct, *broad*, ogival: the mural rim is very thin, little salient, curved, finely striated. The opesium is very large and of the same form as the zooecium. The avicularium is triangular, interzooecial, transverse, and without pivot.

*Measurements.*—Zooecia $\begin{cases} Lz=0.75\text{–}0.95 \text{ mm.} \\ lz=0.50\text{–}0.75 \text{ mm.} \end{cases}$

*Affinities.*—The dietellae open into the zooecia in large pores which are really the remains of multiporous septulae. The ovicell is rare and very small.

The species differs from *Ellisina* (*Semiflustrella*) *rhomboidalis* D'Orbigny, 1852, and *E.* (*Reptoflustrella*) *ovalis* D'Orbigny, 1852,[1] in its dimensions twice as large and in the ogival and nonrhomboidal form of the zooecia. It is the largest known species of *Ellisina*.

*Occurrence.*—Middle Jacksonian: Wilmington, North Carolina (common); Eutaw Springs, South Carolina (rare); near Lenuds Ferry, South Carolina (rare).

Upper Jacksonian (Ocala limestone): 1½ miles above Bainbridge, Georgia (rare); Chipola River, east of Marianna, Jackson County, Florida (rare).

*Holotype.*—Cat. No. 62580, U.S.N.M.

### ELLISINA BREVIS, new species.

Plate 25, figs. 4–6.

The zoarium incrusts other bryozoa. The zooecia are elongated, distinct, oval, *short*, narrowest at the base; the mural rim is very thin, projecting but little, curved, finely striated. The opesium is of the same form as the zooecia. The avicularium is interzooecial, small, oblique, rounded or pointed; two lateral denticles indicate the axis of rotation of the mandible. The ovicell is globular, indistinct, smooth, rarely carinated.

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[1] 1852, Paleontologie Francaise, Terrain Cretace, Bryozoaires, vol. 35, pl. 730, fig. 5, and pl. 731, fig. 16.

*Measurements.*—Zooecia $\begin{cases} Lz=0.50 \text{ mm.} \\ lz=0.25\text{–}0.30 \text{ mm.} \end{cases}$

*Affinities.*—The differences between this species and *Ellisina* (*Reptoflustrella*) *ovalis* D'Orbigny, 1852, are quite insignificant, except that its dimensions are larger and the ovicell is almost never carinated.

It differs from *Ellisina* (*Semiflustrella*) *rhomboidalis* D'Orbigny, 1852, in which the micrometric measurements are almost identical although slightly smaller, in the much less lozenge shape of the zooecia.

*Ellisina brevis* differs from *E. laxa* not only in its much smaller dimensions, but in its elongated zooecia which are less protuberant in aspect. In these very simple forms, the micrometric dimensions are the only constant characters of differentiation.

*Occurrence.*—Middle Jacksonian: Near Lenuds Ferry, South Carolina (rare); Eutaw Springs, South Carolina (rare).

Upper Jacksonian (Ocala limestone): 1½ miles above Bainbridge, Georgia (rare).

*Cotypes.*—Cat. Nos. 63896, 63897, U.S.N.M.

### ELLISINA PROFUNDA MacGillivray, 1895.

Plate 25, fig. 3.

1895. *Membranipora profunda* MacGillivray, A Monograph of the Tertiary Polyzoa of Victoria, Transactions of the Royal Society of Victoria, vol. 4, p. 36, pl. 4. fig. 14; pl. 8, fig. 2.

1908. *Membranipora profunda* Canu, Iconographie des Bryozoaires fossiles de l'Argentine, Anales del Museo Nacional de Buenos Aires, vol. 17, p. 258, pl. 2, fig. 11.

The external aspect, the position, the direction of the avicularia, and the micrometric measurements exactly alike, all indicate or appear to indicate the identity of the American specimens with *Membranipora profunda* MacGillivray, 1895. However, our unique specimen from near Lenuds Ferry, South Carolina, presents a remarkable peculiarity not described by the Australian author and which has not been observed on the specimen from Patagonia. In the interior of each zooecium there is a kind of double partial mural rim; distally two irregular pores separate the two mural rims. This arrangement greatly simulates the structure in the interior of the zooecia of *Chaperia.* The study of this interesting feature remains to be made when more numerous specimens have been found. The avicularium is sometimes developed in the interior of the distal zooecium.

*Occurrence.*—Lower Jacksonian (Moodys marl): Jackson, Mississippi (very rare).

Middle Jacksonian: Near Lenuds Ferry, South Carolina (very rare).

Upper Jacksonian (Ocala limestone): 1½ miles above Bainbridge, Georgia (very rare).

*Geological distribution.*—Miocene of Australia (MacGillivray) and Patagonian of Argentina (Canu).

*Plesiotype.*—Cat. No. 63895, U.S.N.M.

### Genus GRAMMELLA Canu, 1917.

1917. *Grammella* Canu, Bulletin Societe Geologique de France, ser. 4, vol. 16, p. 131.

The operculum closes the ovicell. The avicularium is interzooecial, large, with a solid pivot; its form recalls that of the Greek letter Θ. No dietellae.

*Genotype.*—*Membranipora crassimarginata* Hincks, 1880.

*Range.*—Santonian-Recent.

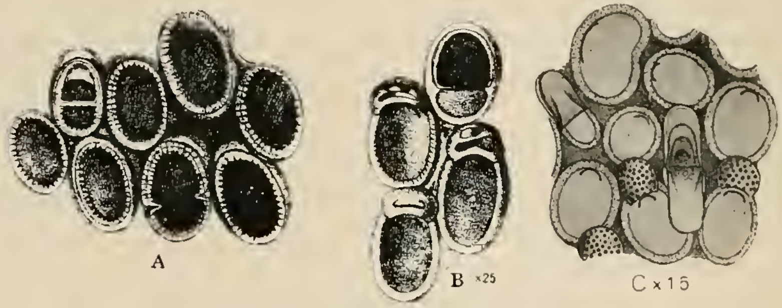

Fig. 32.—Genus *Grammella* Canu, 1917.

A–C. *Grammella crassimarginata* Hincks, 1880. A. Zooecia and avicularia, magnified. (After Hincks, 1880.) B. Several zooecia with ovicell. × 25. (After Waters, 1898.) C. View of the variety *japonica* Ortmann, 1890, × 15. (After Ortmann, 1890.)

The living species of this genus are as follows:

*Grammella* (*Membranipora*) *crassimarginata* Hincks, 1880.
*Grammella* (*Membranipora*) *crassimarginata japonica* Ortmann, 1890.
*Grammella* (*Membranipora*) *papulifera* MacGillivray, 1885.
*Grammella* (*Membranipora*) *sculpta cucullata* Waters, 1898.

The fossil forms are:

*Grammella* (*Membranipora*) *sculpta* MacGillivray, 1894.
*Grammella* (*Eschara*) *lesueuri* Hagenow, 1851.
*Grammella* (*Flustrella*) *confusa* D'Orbigny, 1852.
*Grammella* (*Biflustra*) *megapora* D'Orbigny, 1852.

This is the *Membranipora crassimarginata* group of Waters which he defines as follows: "Ovicell umbonate, with partial rib; avicularia vicarious." He did not indicate the presence of dietellae, but he calls attention to one distal and two lateral septulae.

Waters introduced with doubt into this group (No. 11) the *Membranipora valdemunita* Hincks, 1885, which Canu in 1900 made the type of his artificial subgenus *Valdemunitella.* The form of the large interzooecial avicularia, the absence of the pivot, and the peculiar form of the mandibles are important arguments for the differentiation and the creation of a separate genus, but this is a study for the future.

### GRAMMELLA CRASSIMARGINATA Hincks, 1880.

Plate 24, figs. 13–15.

1880. *Membranipora crassimarginata* Hincks, General History of the Marine Polyzoa, I Madeiran Polyzoa, Annals Magazine Natural History, ser. 5, vol. 6, p. 71, pl. 9, fig. 1.

1891. *Membranipora crassimarginata* Hincks, General History of the Marine Polyzoa, Appendix, Annals and Magazine Natural History, ser. 6, vol. 8, p. 86.

1898. *Membranipora crassimarginata* Waters, Observations on Membraniporidae, Journal Linnean Society London, Zoology, vol. 26, p. 685, pl. 47, fig. 4.

1900. *Crassimarginatella crassimarginata* Canu, Revision des Bryozoaires du cretace figures par d'Orbigny, Pt. 2, Cheilostomata, Bulletin Society Geologique de France, vol. 28, p. 369.

1903. *Oochilina crassimarginata* Norman, Notes on the Natural History of East Finmark. Polyzoa, Annals and Magazine Natural History, ser. 7, vol. 11, p. 595.

1909. *Membranipora crassimarginata* Norman, The Polyzoa of Madeira and neighboring Islands, Journal Linnean Society London, vol. 30, p. 287.

1860. *Membranipora lacroixii* (?) Busk, Description of new Polyzoa, Quarterly Journal of Microscopical Science, vol. 8, p. 282.

1861. *Membranipora irregularis* Busk, Description of new Polyzoa, Quarterly Journal of Microscopical Science, vol. 9 (n. s. vol. 1), p. 77, pl. 33, fig. 3 (not d'Orbigny).

*Description.*—The zoarium incrusts pebbles, shells, foraminifera, and other bryozoa. The zooecia are elongated, distinct, oval, or elliptical with frequently a very small gymnocyst; the mural rim is very prominent, curved, thin at the top, enlarged at the base, finely granular. The opesium is elliptical, entire. The ovicell is globular, prominent, deeply excavated, and separated from the mural rim. The avicularium is interzooecial, as large as a zooecium; the mural rim is thick; the pivot is median and solid.

*Measurements.*—Opesia $\left\{\begin{array}{l} ho=0.32\text{–}0.36\text{ mm.}\\ lo=0.20\text{–}0.22\text{ mm.}\end{array}\right.$ Zooecia $\left\{\begin{array}{l} Lz=0.50\text{ mm.}\\ lz=0.32\text{–}0.40\text{ mm.}\end{array}\right.$

*Variations.*—Examples of total regeneration are numerous and manifest themselves by their double mural rims. Figure 13 contains even a case of triple regeneration. The ancestrula is rather small and of normal form. Closed zooecia perforated by a small, round, medium pore, are located close to the ancestrula (fig. 15).

The micrometric dimensions are identical with those of *Membranipora crassimarginata* relying upon the figure given by Waters. The only difference from the recent species that we can cite is that in the latter the pivot of the avicularium is placed irregularly. On such a trifling difference we can not distinguish another species.

*Grammella crassimarginata* exists to-day in the waters off the Madeira Islands. Its existence in the recent and ancient Gulf of Mexico is therefore very probable.

*Occurrence.*—Middle Jacksonian (Castle Hayne limestone): Wilmington, North Carolina (very rare).

Upper Jacksonian (Ocala limestone): 3½ miles north of Grovania, Georgia (very rare); Alachua, Florida (very rare); 9 miles north of Ocala, Florida (very rare).

*Habitat.*—Mediterranean: off France and Italy. Atlantic: the Madeira Islands and Tristan da Cunha. China Sea. at Tizard. Pacific: Japan (var. *japonica* Ortmann, 1890).

*Plesiotypes.*—Cat. Nos. 63894, 63895, U.S.N.M.

### GRAMMELLA TRANSVERSA Canu and Bassler, 1917.

Plate 25, figs. 7, 8.

1917. *Grammella transversa* CANU and BASSLER, Synopsis of American Early Tertiary Cheilostome Bryozoa, Bulletin 96, United States National Museum, p. 20, pl. 2, fig. 6.

*Description.*—The zoarium incrusts bryozoa. The zooecia are but little elongated, broad, distinct; the mural rim is thin, sharp edged, regular. The opesium is of the same form as the zooecium. The ovicell is salient, globular, smooth, and carinated. The avicularium is interzooecial small, elliptical, and the pivot is never median; its longitudinal axis is *transverse* with respect to the zooecial axis.

*Measurements.*—Opesia $\begin{cases} ho=0.45 \text{ mm.} \\ lo=0.35\text{–}0.40 \text{ mm.} \end{cases}$ Zooecia $\begin{cases} Lz=0.55\text{–}0.60 \text{ mm.} \\ lz=0.46\text{–}0.50 \text{ mm.} \end{cases}$

*Affinities.*—The avicularium is generally elliptical, but it is sometimes triangular (fig. 8). The mural rim exhibits a rare and interesting peculiarity. It is not provided with a side which merges into the zooecium so that the opesium is bounded by the termen itself of the mural rim.

The present form differs from other described species of *Grammella* in its small avicularia transversally oriented.

*Occurrence.*—Middle Jacksonian: Wilmington, North Carolina (rare); Eutaw Springs, South Carolina (very rare).

*Cotypes.*—Cat. No. 62579, U.S.N.M.

### GRAMMELLA PUSILLA, new species.

Plate 25, figs. 9–13.

*Description.*—The zoarium incrusts other bryozoa and calcareous algae. The zooecia are *small*, elongated, distinct, oval, or elliptical, with or without a very small gymnocyst; the mural rim is quite prominent, thin at the top, enlarged at the base, finely granulated. The opesium is elliptical. The ovicell is globular, granulose, deeply excavated, ornamented, with a callosity, and distinct from the mural rim. The ancestrula is small and its mural rim very thin. The avicularium is interzooecial, somewhat larger than an opesium; its pivot is placed a little below the transverse axis of the opesial ellipse.

*Measurements.*—Opesia $\begin{cases} ho=0.26 \text{ mm.} \\ lo=0.18 \text{ mm.} \end{cases}$ Zooecia $\begin{cases} Lz=0.40 \text{ mm.} \\ lz=0.22\text{–}0.26 \text{ mm.} \end{cases}$

Examples of total regeneration are very rare.

*Affinities.*—The termen of the mural rim sometimes becomes very sharp and crenulated (fig. 10).

This species is quite similar to *Grammella crassimarginata*, differing only in its small dimensions. It is not a variety because it occurs at different localities.

*Occurrence.*—Middle Jacksonian: 18 miles west of Wrightsville, Johnson County, Georgia (very rare).

Upper Jacksonian (Ocala limestone): West bank of Sepulga River, Escambia County, Alabama (rare); Chipola River, east of Marianna, Jackson County, Florida (rare); 1½ miles above Bainbridge, Georgia (rare).

Vicksburgian ("Chimney rock" of Marianna limestone): One mile north of Monroeville, Alabama (rare).

*Cotypes.*—Cat. Nos. 63898, 63899, U.S.N.M.

## Genus MEMBRANIPORIDRA Canu and Bassler, 1917.

1917. *Membraniporidra* CANU and BASSLER, Synopsis of American Early Tertiary Cheilostome Bryozoa, Bulletin 96, United States National Museum, p. 21.

The operculum always closes the ovicell. No dietellae. No avicularia. One large distal septula; two pairs of lateral septulae.

*Genotype.*—*Membraniporidra porrecta* Canu and Bassler, 1917.

*Range.*—Jacksonian and Vicksburgian.

The ovicell is deeply excavated in the distal zooecium. It is only by dissection that we are able to prove by the continuity of the mural rim, although very thin distally, that the ovicell is indeed hyperstomial. The mural rim is always enlarged at the base and finely granular.

This genus differs from *Alderina* Norman, 1903, not only in the closure of the ovicell by the opercular valve, but also in the absence of dietellae.

It is probable that many recent species may be included in this genus. The most common form among them might well serve as the true genotype.

### MEMBRANIPORIDRA OECIOPOROSA, new species.

Plate 26, figs. 1, 2

*Description.*—The zoarium incrusts shells. The zooecia are elongated, distinct, elliptical; the mural rim is slightly salient, curved, enlarged at the base, where it has two lateral furrows, ornamented with very small granulations radially arranged. The opesium is elliptical. The ovicell is large, globular, salient, ornamented with a frontal callosity, the wall of which, lying on the distal part of the zooecium, is finely *porous*.

*Measurements.*—Opesia $\left\{\begin{array}{l} ho=0.22\text{–}0.25 \text{ mm.}\\ lo=0.15\text{–}0.17 \text{ mm.}\end{array}\right.$ Zooecia $\left\{\begin{array}{l} Lz=0.35 \text{ mm.}\\ lz=0.23\text{–}0.25 \text{ mm.}\end{array}\right.$

*Variations.*—This species is very irregular is its gemmation, and deformed zooecia are numerous. The ovicell is interesting for its peculiarities—a fragile, frontal callosity and finely porous floor. The callosity is finely granular like the mural rim; it is an olocyst partially covered with a pleurocyst. The ovicell borders the mural rim in a very irregular fashion; we are not absolutely certain that the opercular valve always closes the zooecia. Moreover, as we possess only a very small number of fragments, this species requires further examination.

*Occurrence.*—Lower Jacksonian (Moodys marl): Jackson, Mississippi (very rare).

Middle Jacksonian: Eutaw Springs, South Carolina (very rare); Rich Hill, 5¼ miles southeast of Knoxville, Georgia (very rare); Wilmington, North Carolina (very rare).

*Cotypes.*—Cat. Nos. 63902, 63903, U.S.N.M.

### MEMBRANIPORIDRA PACHYMURALIS, new species.

Plate 28, figs. 14–17.

*Description.*—The zoarium incrusts shells. The zooecia are slightly elongated, distinct, hexagonal; the mural rim is very *wide* on the margins and below, finely granular. The opesium is elongated, elliptical, fringed with a collar of granules radially arranged. The ovicell is much sunken, but placed above the distal septula: it is closed above by a globular, salient convexity, separated from the mural rim and formed of two calcareous layers.

*Measurements.*—Opesia $\left\{\begin{array}{l} ho=0.35\text{–}0.40 \text{ mm.} \\ lo=0.20 \text{ mm.}\end{array}\right.$ Zooecia $\left\{\begin{array}{l} Lz=0.55\text{–}0.60 \text{ mm.} \\ lz=0.45\text{–}0.50 \text{ mm.}\end{array}\right.$

*Variations.*—The zooecia are generally separated by a furrow of slight depth and sometimes filled up. The mural rim on account of its thickness is a true cryptocyst which renders this species very easy of determination. We are ignorant of the use of the radially arranged granulations which fringe the opesium. No regenerated zooecia have been observed. The rather large distal septula becomes multiporous.

*Occurrence.*—Middle Jacksonian (Castle Hayne limestone): Wilmington, North Carolina (rare).

*Holotype.*—Cat. No. 63917, U.S.N.M.

### MEMBRANIPORIDRA TRIGEMMA, new species.

Plate 25, figs. 14, 15.

The zoarium is unilamellar and creeps over algae. The zooecia are rather large, little elongated, ogival, distinct; the mural rim is thin, little prominent, curved, much enlarged at the base, finely granular. The opesium is elliptical or subcircular, finely denticulated. The ovicell is large, globular, salient, distinct from the mural rim, with a deeply embedded floor.

*Measurements.*—Opesia $\left\{\begin{array}{l} ho=0.46\text{–}0.50 \text{ mm.} \\ lo=0.36\text{–}0.40 \text{ mm.}\end{array}\right.$ Zooecia $\left\{\begin{array}{l} Lz=0.60 \text{ mm.} \\ lz=0.55 \text{ mm.}\end{array}\right.$

*Affinities.*—In general, in gemmation a zooecium may engender only two, of which the one that is deformed becomes primoserial. Here this gemmation is so vigorous that very frequently a zooecium, in every respect larger than the others, reproduces *three* undeformed primoserial zooecia. We have observed no regenerated zooecia.

This species differs from *Membraniporidra laticella* in its larger micrometric dimensions and in the absence of a gymnocyst.

*Occurrence.*—Middle Jacksonian: Wilmington, North Carolina (common); Rich Hill, 5¼ miles southeast of Knoxville, Georgia (rare).

*Cotypes.*—Cat. Nos. 63900, 63901, U.S.N.M.

### MEMBRANIPORIDRA LATICELLA, new species.

Plate 26, figs. 3–5.

Zoarium incrusting other bryozoa. The zooecia are distinct, ogival, *broad*, with a small convex gymnocyst; the mural rim is salient, thin, curved, smooth, or slightly granular. The opesium is entire, oval, the narrow end at the front. The ovicell is large, globular, salient, smooth, distinct from the mural rim; it is deeply embedded in the distal zooecium.

*Measurements.*—Opesia $\begin{cases} ho=0.40\text{–}0.50 \text{ mm.} \\ lo=0.20\text{–}0.30 \text{ mm.} \end{cases}$ Zooecia $\begin{cases} Lz=0.60\text{–}0.80 \text{ mm.} \\ lz=0.40\text{–}0.50 \text{ mm.} \end{cases}$

*Variations.*—The mural rim is not always round. It sometimes has a small sharp termen dividing it into two parts. The gymnocyst is very irregular in form, but it is a constant feature. The regenerated zooecia with double mural rims are frequent. Figure 4 (*zri*) represents a special case where a regenerated zooecium replaces a normal zooecium but reversed in direction. Figure 5 (*zro*) illustrates an inverted ovicelled zooecium succeeding a normal zooecium.

This species differs from *Membraniporidra trigemma* in its smaller zooecial dimensions and in the presence of a gymnocyst.

*Occurrence.*—Middle Jacksonian: Wilmington, North Carolina (very common); Eutaw Springs, South Carolina (rare).

*Cotypes.*—Cat. No. 63904, U.S.N.M.

### MEMBRANIPORIDRA PORRECTA Canu and Bassler, 1917.

Plate 26, figs. 6–13.

1917. *Membraniporidra porrecta* Canu and Bassler, Synopsis of American Early Tertiary Cheilostome Bryozoa, Bulletin 96, United States National Museum, p. 21. pl. 2, fig. 5.

The zoarium is free, follicular, formed of two very thin leaves growing back to back and easily separable. The zooecia are large, elongate, distinct, oval, with a proximal, convex gymnocyst; the mural rim is very thin, salient, curved. The opesium is large, elliptical, entire. The ovicell is globular, little elevated, ornamented with a frontal callosity; it is deeply embedded. A distal septula and two lateral septulae and two distal impressions are present.

*Measurements.*—Opesia $\begin{cases} ho=0.75 \text{ mm.} \\ lo=0.30 \text{ mm.} \end{cases}$ Zooecia $\begin{cases} Lz=0.95 \text{ mm.} \\ lz=0.38 \text{ mm.} \end{cases}$

*Variations.*—The micrometric variations in this species are very great: there are long zooecia (figs. 7, 8), wide zooecia (figs. 9, 10), and dwarfed zooecia (fig. 7). The furrow separating the zooecia is often filled and replaced by a thread-like projection. Some cases of total regeneration have been noticed. The ovicell is rare and fragile, its callosity is very finely granular like the mural rim. The mural rim according to the rule is an olocyst in which the elements group themselves, radiating from the opesium. The gymnocyst is formed of scattered olocystal elements (fig. 13). These tissues are very hard and it is very difficult to obtain them in thin sections. Two very faint distal impressions exist on the dorsal olocyst at the bottom of each zooecium.

*Occurrence.*—Middle Jacksonian: Wilmington, North Carolina (common); Baldock, Barnwell County, South Carolina (rare).

*Cotypes.*—Cat. No. 62578, U.S.N.M.

### MEMBRANIPORIDRA SPISSIMURALIS, new species.

Plate 27, figs. 1–19; plate 28, figs. 1–7.

The zoarium is free, follicular, formed of two lamellae growing back to back and easily separable. The zooecia are elongated, oval, distinct, separated by a furrow or by a raised thread-like line. The mural rim is flat, oblique toward the opesium, *thick*, gradually enlarging to form at the base a cryptocyst limited laterally by two grooves or furrows. The opesium is elliptical, entire, often partially cut off by the rectangular prominent denticles. The primoserial zooecia have an opesium narrowed laterally. The ovicell is globular, salient, short, transverse, and is deeply embedded in the distal zooecium. There are two pairs of lateral septulae and a very large distal septula.

*Measurements.*—Opesia $\begin{cases} ho=0.45 \text{ mm.} \\ lo=0.22 \text{ mm.} \end{cases}$ Zooecia $\begin{cases} Lz=0.72 \text{ mm.} \\ lz=0.35 \text{ mm.} \end{cases}$

*Variations.*—This species is very common and, as usual in such a case, the variations are innumerable. It is truly a protean form of the Membranipores. The imagination can not conceive all the variations; we will note only the principal ones. Certain of these variations affect not only an entire zoarium but often all of the zoaria from the same locality.

Our description is founded on the perfect but rare forms (figs. 1, 2, 3). The cryptocyst may lack the lateral grooves; again it is concave (pl. 27, figs. 4, 5), and then it is convex (pl. 27, figs. 6, 7). It may even be wanting entirely either naturally (pl. 27, fig. 8) or by weathering (pl. 27, fig. 9). This latter variation affects nearly all the specimens from Rich Hill, Georgia.

The mural rim of young zooecia is thinner than usual (pl. 27, figs. 3, 12, 13). Rarely the primoserial zooecia do not have an opesium laterally contracted (pl. 27, figs. 1, 2). This contraction is a very important character, chiefly in the rolled and worn specimens.

We have observed monstrous zooecia from the Vicksburgian near Monroeville, Alabama (pl. 27, fig. 14), and furthermore the extremely rare case of a zooecium giving rise to five primoserial zooecia (pl. 27, fig. 15).

The granulations of the mural rim are extremely fine; the granules become larger by chemical changes (pl. 27, fig. 16). The ovicell is smooth in the Jacksonian specimens (pl. 27, figs. 3, 7), but it is ornamented with a frontal callosity in those from the Vicksburgian (pl. 27, figs. 16, 17). This structure is always placed above the distal septula (pl. 28, fig. 6). The ovicells on the same zoarium are rare, and their occurrence in groups is very infrequent (pl. 27, fig. 9). Regenerated zooecia are rather rare (pl. 27, fig. 14). The opesial denticles are always irregular in form, size, and position; sometimes they are quite large (pl. 27, fig. 18).

The zoarium is often unilamellar, either by splitting in half or by growth on algae (pl. 27, fig. 19). This variation affects all the specimens from the Vicksburgian along the west bank of Conecuh River, Escambia County, Alabama. We have also some specimens incrusting shells from the Jacksonian at Wilmington, North Carolina.

The dorsal lamella of each zooecium is an olocyst with scattered elements (pl. 28, fig. 3). The mural rim and the cryptocyst are of the same nature and are formed by an olocyst in which the elements are grouped in radial lines (pl. 28, fig. 2). The zooecial walls are very thin (pl. 28, fig. 4) or very thick (pl. 28, fig. 5). By rubbing away the surface it is easy to bring out the two pairs of lateral septulae and the large distal septula (pl. 28, fig. 5). On the same zoarium the micrometric measurements are rather constant, but they vary much according to the locality. They may be small (pl. 27, fig. 10) or large (pl. 27, figs. 5, 8, 14).

*Occurrence.*—Vicksburgian (Marianna limestone): Salt Mountain, five miles south of Jackson, Alabama (very common); near Claiborne, Monroe County, Alabama (very common); west bank of Conecuh River, Escambia County, Alabama (very common); Murder Creek, east of Castlebury, Conecuh County, Alabama (very common); 1 mile north of Monroeville, Alabama (very common).

Upper Jacksonian (Ocala limestone): West bank of Sepulga River, Escambia County, Alabama (rare); Chipola River, east of Marianna, Jackson County, Florida (very rare).

Jacksonian (Zeuglodon zone): Shubuta, Mississippi (rare).

Middle Jacksonian: Wilmington, North Carolina (very common); 3¼ miles south of Perry, Georgia (common); Rich Hill, 5½ miles southeast of Knoxville, Crawford County, Georgia (common); 18 miles west of Wrightsville, Johnson County, Georgia (common); 12 miles southeast of Marshallville, Georgia (common); one-half mile southeast of Georgia Kaolin Company Mine, Twiggs County, Georgia (rare); Baldock, Barnwell County, South Carolina (rare).

Lower Jacksonian (Moodys marl): Jackson, Mississippi (rare).

*Cotypes.*—Cat. Nos. 63905–63911, U.S.N.M.

### MEMBRANIPORIDRA SIMILIS, new species.

Plate 28, figs. 8–10.

*Description.*—The zoarium incrusts other bryozoa and pebbles. The zooecia are elongated, little distinct, separated or not by a very little furrow, elliptical; the mural rim is thin at the top, enlarged below, finely granular. The opesium is regularly elliptical, very finely crenulated. The primoserial zooecia are modified. The ovicell is large, distinct from the mural rim, salient, globular, almost transverse, and is deeply embedded in the distal zooecium.

*Measurements.*—Opesia $\begin{cases} ho=0.36\text{–}0.44 \text{ mm.} \\ lo=0.20\text{–}0.30 \text{ mm.} \end{cases}$ Zooecia $\begin{cases} Lz=0.50\text{–}0.60 \text{ mm.} \\ lz=0.30\text{–}0.40 \text{ mm.} \end{cases}$

*Affinities.*—We have chosen for illustration specimens showing the most constant features, but the variations are numerous. The least roughness of the substratum modifies the micrometric dimensions very much.

The primoserial zooecia have no decided form and they sometimes assume the shape of large interzooecial avicularia. A zoarium from Old Factory near Bainbridge, Georgia, covers four square centimeters. The distal septula is rather large, but it is only easily visible after abrasion of the surface.

This species resembles *Membraniporidra spissimuralis* very much, but it differs in the absence of a cryptocyst with lateral grooves and in the smaller micrometric dimensions ($Lz=0.60$ mm.),

*Occurrence.*—Middle Jacksonian: Near Lenuds Ferry, South Carolina (common); Eutaw Springs, South Carolina (very rare).

Upper Jacksonian (Ocala limestone): Old Factory, 1½ miles above Bainbridge, Georgia (rare).

Vicksburgian ("Chimney rock" of Marianna limestone): One mile north of Monroeville, Alabama (rare); Vicksburg, Mississippi (very rare in the lower beds).

*Cotypes.*—Cat. No. 63912, U.S.N.M.

### MEMBRANIPORIDRA PYRIFORMIS, new species.

Plate 28, figs. 11–13.

*Description.*—The zoarium incrusts oyster shells and pebbles. The zooecia are elongate, distinct, *pyriform*, with or without a small gymnocyst; the mural rim is thick, curved, salient, broader below. The opesium is entire, pyriform and anterior. The ovicell is a little distal embedded niche covered by a slightly salient convexity.

*Measurements.*—Opesia $\begin{cases} ho=0.35\text{–}0.40 \text{ mm.} \\ lo=0.25\text{–}0.30 \text{ mm.} \end{cases}$ Zooecia $\begin{cases} Lz=0.50\text{–}0.55 \text{ mm.} \\ lz=0.45\text{–}0.50 \text{ mm.} \end{cases}$

*Affinities.*—The very small ovicell is often difficult to discover on specimens a little altered by fossilization. It is hyperstomial, that is to say, buried in the distal zooecium, but it is so embedded that it can not be considered as endozooecial. Everywhere it opens into the interior of the zooecium below the opercular valve.

This species has somewhat the aspect of *Membranipora appendiculata* Reuss, 1847, but differs from it in the absence of avicularia.

*Occurrence.*—Upper Jacksonian (Ocala limestone): Old Factory, 1½ miles above Bainbridge, Georgia (common); Red Bluff, 7 miles above Bainbridge, Georgia (very rare), Bainbridge, Georgia (rare); Chipola River, east of Marianna, Jackson County, Florida (very rare); west bank of Sepulga River, Escambia County, Alabama (common).

*Cotypes.*—Cat. Nos. 63915, 63916, U.S.N.M.

KEY TO AMERICAN SPECIES OF MEMBRANIPORIDRA.

| | | |
|---|---|---|
| 1. | Zoarium bilamellar | 2 |
| | Zoarium incrusting | 3 |
| 2. | Gymnocyst convex without lateral grooves | *M. porrecta.* |
| | Gymnocyst concave with lateral grooves | *M. spissimuralis.* |
| 3. | Ovicell with porous floor | *M. occioporosa.* |
| | Floor nonporous | 4 |
| 4. | Ovicell very small | *M. pyriformis.* |
| | Ovicell large, transverse | 5 |
| 5. | Gymnocyst present | *M. laticella.* |
| | No gymnocyst | 6 |
| 6. | Two primoserial nondeformed zooecia (*lz* 0.55 mm.) | *M. trigemma.* |
| | One primoserial deformed zooecium (*lz* 0.40 mm.) | *M. similis.* |

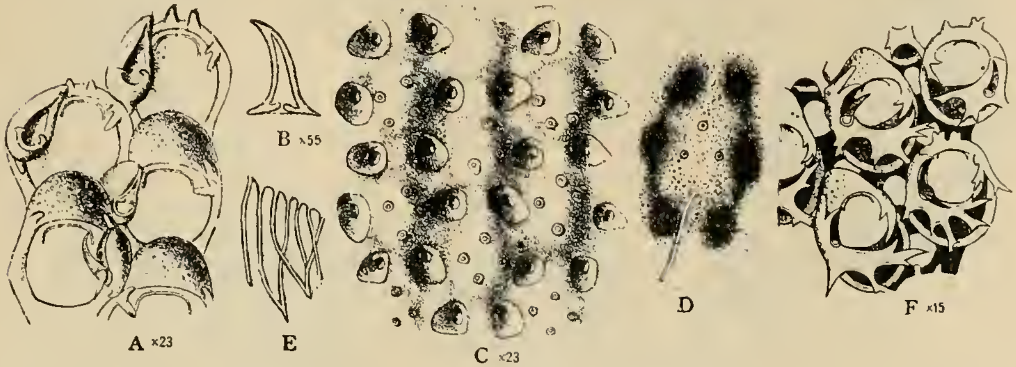

FIG. 33.—Genus *Tremopora* Ortmann, 1890.

A–E. *Tremopora radicifera* Hincks. 1881. A. Several zooecia with ovicell, × 23. B. Avicularian mandible, × 55. C. View of the basal surface, × 23. (A–C after Levinsen, 1909.) D. View showing radicular pores and pore tubes. E. Radical fibers. (D, E after Hincks, 1881.)

F. *Tremopora dendracantha* Ortmann. 1890. Several zooecia showing the large bifurcated oral spines, × 15. (After Ortmann. 1890.)

### Genus TREMOPORA Ortmann, 1890.

1890. *Tremopora* ORTMANN, Die Japonische Bryozoen Fauna. Archiv. für Naturgeschichte, vol. 50, p. 29.

The opercular valve always closes the ovicell. The mural rim bears one or two large bifurcated oral spines and an avicularium more or less developed.

*Genotype.*—*Tremopora dendracantha* Ortmann, 1890.

*Range.*—Helvetian-Recent.

The zooecia are adjacent or separated and are joined among themselves by connecting tubes. The lower face often has radicels. Waters classed this genus in the *Membranipora patellaria* group. Levinsen incorporated it in his family Bicellariidae.

### Genus LARNACIUS Norman, 1903.

1903. *Larnacius* NORMAN, Notes on the Natural History of East Finmark, Annals and Magazine Natural History, ser. 7, vol. 12, p. 87.

This genus differs from *Amphiblestrum* Gray, 1848, first in the interzooecial avicularium with pivot, second in the absence of dietellae, third in the distal end of the zooecium, which is divided into chambers by means of a transverse and usually one or two vertical connecting bars. The ovicell appears closed by the operculum.

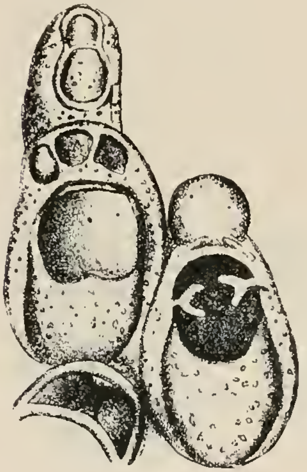

FIG. 34.—Genus *Larnacius* Norman, 1903.

*Larnacius corniger* Busk, 1852. Several zooecia, highly magnified, one with ovicell and the others with chambers in the place usually occupied by an ovicell. (After Norman, 1903.)

*Genotype.*—*Larnacius* (*Membranipora*) *corniger* BUSK, 1852. Recent.

The genus *Larnacius* may belong to a distinct family.

### SECTION IV. OVICELL NEVER CLOSED BY OPERCULAR VALVE.

The ovicell is widely open above the operculum and the opesium. In the fossil forms the distal part of the mural rim is visible and not modified: the distal cicatrix left by the broken ovicell on the superior zooecium is shallow. In the recent species this kind of ovicell is closed by a vesicle which retracts or dilates by means of special muscles to facilitate the departure of the larvae or the entrance of the eggs.

In the recent dry specimens the orifice of the ovicell appears simply closed by the ectocyst which always covers this structure.

Levinsen in his "Studies on the Cheilostomatous Bryozoa" classes all the species of this group in the single genus *Callopora* Gray, 1848. We believe with Norman that the presence, the form, and the position of the avicularia may serve for the establishment of natural although less important generic divisions.

### Genus ALDERINA Norman, 1903.

1903. *Alderina* NORMAN, Notes on the Natural History of East Finmark. Annals Magazine Natural History, ser. 7. vol. 11. p. 596.

Front wall entirely membranous, side walls usually crenulated; no lateral spines. No avicularia, but nodulous processes sometimes developed in different positions on the side of the zooecium. Ovicell usually bearing (either a rib or) a depressed area in front. Dietellae in the type, two pairs of lateral and two distinctly marked and separated distal. As in *Ellisina*, the two front pairs of dietellae usually extend outside the lateral walls, and the two posterior inside. (Norman, 1905).

*Genotype.*—*Alderina* (*Membranipora*) *imbellis* Hincks, 1860.

*Range.*—Senonian-Recent.

The following species are classed in this genus:

*Alderina* (*Membranipora*) *imbellis* Hincks, 1860. Recent.
*Alderina* (*Membranipora*) *irregularis* Smitt, 1872. Recent.
*Alderina* (*Membranipora*) *solidula* Hincks, 1860. Recent.
*Alderina* (*Biflustra*) *ovalis* D'Orbigny, 1852. Senonian.
*Alderina* (*Flustrellaria*) *franqana* D'Orbigny, 1852. Senonian.

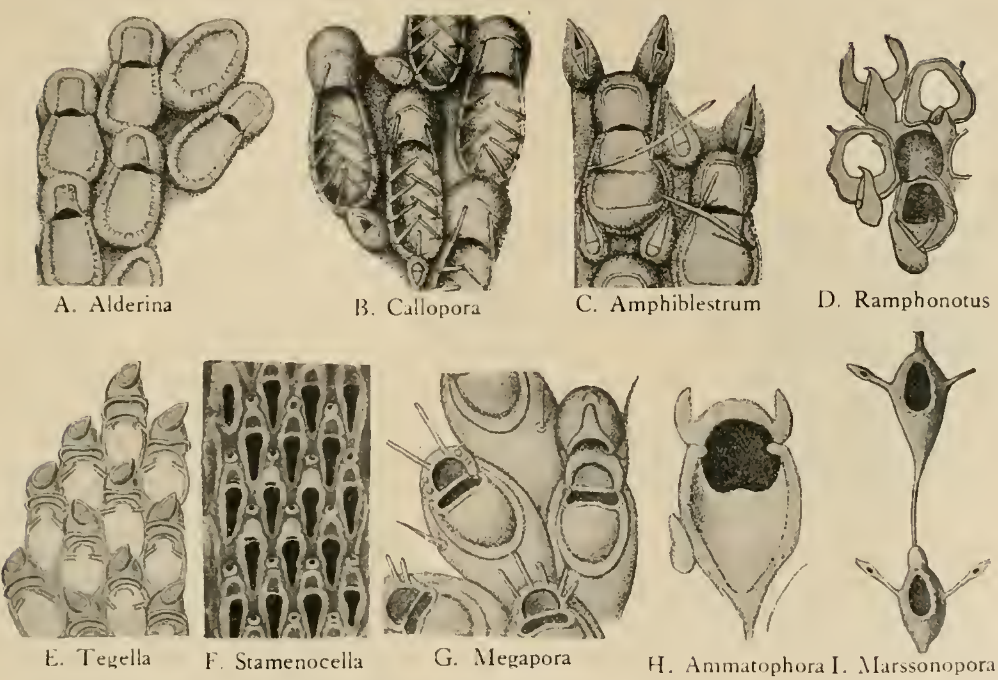
A. Alderina
B. Callopora
C. Amphiblestrum
D. Ramphonotus
E. Tegella
F. Stamenocella
G. Megapora
H. Ammatophora
I. Marssonopora

FIG. 35.—Genera of Membraniporae with ovicells never closed by the opercular valve.
A. *Alderina imbellis* Hincks, 1880, × 25. Recent.
B. *Callopora lineata* Linnaeus, 1758, × 50. Recent.
C. *Amphiblestrum flemingi* Busk, 1875, × 50. Recent.
D. *Ramphonotus minax* Busk, 1860, × 25. Recent.
E. *Tegella unicornis* Fleming, 1828, × 20. Recent.
F. *Stamenocella pyriformis*, new species. × 20. Lower Jacksonian, Jackson, Mississippi.
G. *Megapora ringens* Hincks, 1880, × 50. Recent.
H. *Ammatophora nodulosa* Hincks, 1880. Recent.
I. *Marssonopora dispersa* Hagenow, 1837. Cretaceous (Senonian) Isle of Rügen.

*Alderina* (*Membranipora*) *abortiva* Canu, 1911. Rocanean.
*Alderina* (*Membranipora*) *cummingsi* Canu, 1911. Rocanean.
*Alderina* (*Membranipora*) *perisparsa* Novak, 1877. Cenomanian.

The recent species *Alderina irregularis* Smitt, 1872, is very important in the American forms, and as it has been confused with other species we believed it useful to make known its synonymy and history.

### ALDERINA IRREGULARIS Smitt, 1872.

1872. *Membranipora irregularis* SMITT, Floridan Bryozoa, Kongl. Svenska Vetenskaps-Akademiens Handlingar, vol. 10, No. 11, p. 8, pl. 11, fig. 63.
1914. *Membranipora irregularis* OSBURN, The Bryozoa of the Tortugas Islands, Florida, Publication Carnegie Institution of Washington, No. 182, p. 194.
Not D'ORBIGNY, 1839, WATERS, 1904, BUSK, 1861, MANZONI, 1875.

*Observations.*—We owe to the kindness of Doctor Osburn a very complete, superb specimen of this interesting species, and we are able to supplement the observations which are indispensable for its classification. The ovicell is transverse and formed of two calcified layers; the superior one is very finely granulated, incomplete, surrounding an area which is irregular and more or less linear. It is hyperstomial and opens by a large special orifice which the opercular valve never closes. The latter is bordered by a very thick sclerite. The mural rim is granular and enlarged at the base. This is a very well characterized species of *Alderina*.

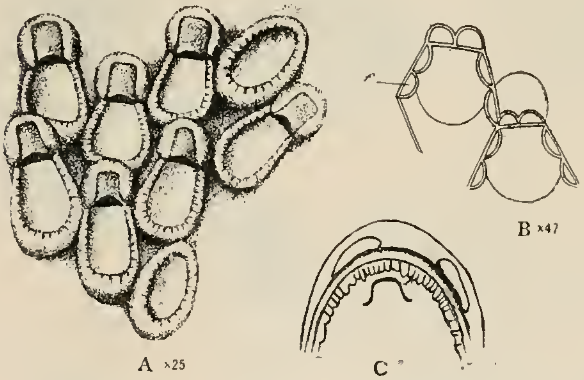

FIG. 36.—Genus *Alderina* Norman, 1903.

A, B. *Alderina imbellis* Hincks, 1860. A. Zooecia, × 25. (After Hincks, 1880.) B. Sketch showing dietellae, × 47. (After Levinsen, 1894.)

C. *Alderina solidula* Hincks, 1860. A young zooecium at the edge of a zoarium. (After Norman, 1903.)

*Measurements.*—Opesia $\begin{cases} ho=0.34 \text{ mm.} \\ lo=0.20 \text{ mm.} \end{cases}$

Zooecia $\begin{cases} Lz=0.40\text{–}0.56 \text{ mm.} \\ lz=0.30\text{–}0.40 \text{ mm.} \end{cases}$

*Affinities.*—This species is the equatorial representative of the boreal *Alderina imbellis* Hinck, 1860. It differs from it in its transverse and nonelongated ovicell and its irregularly linear and nonrectangular ovicellarian area.

Smitt in 1872 identified it with *Membranipora irregularis* D'Orbigny, 1839. The type is no longer to be found at the Museum of Natural History of Paris. The figure does not show an ovicell; as the mural rim is smooth and is not enlarged at the base, it certainly represents a different species from that of Smitt. Waters in 1904[1] found it almost in the same regions; he figured its ovicell but without giving its nature; the micrometric dimensions are much larger, to wit: $ho=0.60$ mm., $lo=0.32$ mm., $Lz=0.80$ mm., $lz=0.44$ mm. If it should be proved that this is an *Alderina* it would be necessary to rename Smitt's species of much later date.

Busk in 1861[2] thought he had found D'Orbigny's species in the Madeira Islands. The figure which he gives is in effect very close to that of the French author; the mural rim is not enlarged at the base: this is, therefore, not the species of Smitt. As the ovicell was not figured, we can not compare it with the species of Waters.

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[1] 1904. Waters, Bryozoa, Result. Voyage *Belgica* Zool., p. 31, pl. 11, fig. 6.

[2] 1861. Busk, Description of new Polyzoa, collected at Madeira in 1859 and 1860, Quarterly Journal Microscopical Science, new ser., vol. 1, p. 77, pl. 33, fig. 3.

Manzoni in 1875[1] thought also that he had found D'Orbigny's species in the Plaisancian sands of Castrocaro, in Italy. His figure is very similar to that of Smitt, 1872, although it will be difficult to get an exact idea of the ovicell from it. In 1893, Neviani,[2] revising the Manzoni collection, stated that *Membranipora irregularis*, *M. catenularia*, and *M. lineata* of this author form one and the same species, all appearing to have interzooecial avicularia. Under these conditions it is evident that the Manzoni species is different from that of D'Orbigny and also of Smitt. The paleontologist who rediscovers it will have to rename it.

*Habitat.*—Pourtales has dredged this species off Florida to a depth of 97 meters. Osburn has noted it off the Tortugas Islands from 13 to 15 meters.

It creeps over shells and Nullipores.

*Alderina imbellis* Hincks, 1860, is a very rare species. It inhabits the deep waters off England (Hinck. 1880), Denmark (Levinsen, 1894), and Norway (Norman, 1879).

## ALDERINA? NODULOSA, new species.

Plate 9, fig. 10.

*Description.*—The zoarium is free, unilamellar, creeping over algae. The zooecia are elongated, distinct, oval, bearing inferiorly one to two projecting *nodules:* the mural rim is thin at the top, much enlarged below, curved, delicately decorated with radially arranged granules. The opesium is oval, finely crenulated. The ovicell is hyperstomial and never closed by the operculum, salient, globular, elongated. The distal septula may be replaced by three smaller septulae. The first pair of lateral septulae is very large; the two other pairs of lateral septulae are smaller and may each be replaced by two smaller ones. This arrangement of the septulae is visible exteriorly.

*Measurements.*—Opesia $\begin{cases} ho=0.32\text{–}0.35 \text{ mm.} \\ lo=0.20\text{–}0.25 \text{ mm.} \end{cases}$

Zooecia $\begin{cases} Lz=0.45 \text{ (2 nodules)–}0.62 \text{ mm. (1 nodule).} \\ lz=0.30\text{–}0.35 \text{ mm.} \end{cases}$

*Affinities.*—This elegant species is quite remarkable on account of its plainly visible septular arrangement. A large septula is sometimes, without any apparent reason, replaced by two or three smaller ones closely arranged. The long zooecium with a single inferior nodule appears to be primoserial.

On account of its nodules and its external aspect, this species somewhat resembles *Alderina solidula* Hincks, 1860, in which, however, the septular arrangement is binary. Its arrangement of the septulae in threes would suggest its position in the genus *Cauloramphus* Norman, 1903, but the ovicells of the species of this genus are either unknown or endozooecial. The septular arrangement and the nature of its mural rim also are as in *Antropora* Norman, 1903; but species of this genus are provided with avicularia. To be exact, it would be necessary to create a new genus, but as we possess only the single specimen figured, we think it prudent to await for more abundant material.

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[1] 1875. Manzoni, I. Briozoi del Pliocene antico di Castrocaro, Bologna, p. 10, pl. 1, fig. 5.

[2] 1893. Neviani, Seconda contribuzione alla conoscenza dei Briozoi fossili italiani, Bollettino della Società geologica italiana, vol. 13, p. 9.

*Occurrence.*—Wilcoxian (Bashi formation): Woods Bluff, Alabama (very rare).

*Holotype.*—Cat. No. 63833, U.S.N.M.

### ALDERINA PULCHERRIMA, new species.

Plate 29, fig. 1.

*Description.*—The zoarium is free, unilamellar, creeping over algae. The zooecia are large, elongated, elliptical; the mural rim is broad, concave, smooth, enlarged below. The opesium is elliptical, elongated, entire. The ovicell is hyperstomial and never closed by the opercular valve, is globular, very salient, distinct from the mural rim, furrowed in front; it is formed of two calcareous lamellae of which the exterior one is of the same nature as the mural rim.

*Measurements.*—Opesia $\left\{\begin{array}{l} ho=0.80 \text{ mm.} \\ lo=0.50 \text{ mm.} \end{array}\right.$ Zooecia $\left\{\begin{array}{l} Lz=1.20 \text{ mm.} \\ lz=0.80 \text{ mm.} \end{array}\right.$

This very beautiful species has no related form either fossil or living.

*Occurrence.*—Middle Jacksonian: Wilmington, North Carolina (very rare); near Lenuds Ferry, South Carolina (very rare).

Lower Jacksonian (Moodys marl): Jackson, Mississippi (very rare).

*Holotype.*—Cat. No. 63918, U.S.N.M.

### ALDERINA LUNATA, new species.

Plate 29, fig. 5.

*Description.*—The zoarium incrusts bryozoa. The zooecia are distinct, separated by a deep, somewhat elongated, oval furrow; the mural rim is very thin distally, somewhat enlarged proximally, granulated. The opesium is elongated, elliptical, or oval, and very finely crenulated. The ovicell is globular, salient, and transverse; the frontal area is in the form of a *crescent* and granulated like the mural rim.

*Measurements.*—Opesia $\left\{\begin{array}{l} ho=0.30\text{–}0.32 \text{ mm.} \\ lo=0.22\text{–}0.25 \text{ mm.} \end{array}\right.$ Zooecia $\left\{\begin{array}{l} Lz=0.40\text{–}0.50 \text{ mm.} \\ lz=0.25\text{–}0.30 \text{ mm.} \end{array}\right.$

*Affinities.*—This species differs from the recent *Alderina imbellis* Hincks, 1860, in the less length of its ovicell (0.15 instead of 0.20 mm.) and its frontal area, which is in the form of a crescent instead of being rectangular. These differences are insignificant, for the micrometric measurements are identical, and they occur almost within the possibilities of the habitual variations of a species. If we have created a distinct species it is because *Alderina imbellis* has never been found fossil, and because such a sudden appearance in the Lower Eocene seems to us too unusual.

A more closely related species is *Alderina irregularis* Smitt, 1872, in which the micrometric dimensions are also identical. It differs from it simply in its crescent form and the nonregularity of the area of the ovicell. This is therefore an intermediate form between *Alderina imbellis* Hincks, 1860, and *Alderina irregularis* Smitt, 1872; perhaps it is an ancestral fossil form of those two recent species, one of which is boreal and the other equatorial.

From this example the reader may judge of the great difficulties which often afflict us in the determination of the Membranipores.

*Occurrence.*—Lower Jacksonian (Moodys marl): Jackson, Mississippi (very rare).

*Holotype.*—Cat. No. 63922, U.S.N.M.

### ALDERINA CRASSA, new species.

Plate 29, fig. 7.

*Description.*—The zoarium incrusts the radial plates of sea urchins. The zooecia are slightly elongated, distinct; the mural rim is *very thick*, convex, salient, granular. The opesium is elongated, elliptical, median. The ovicell is hyperstomial.

*Variations.*—We possess only the single figured specimen, which is incomplete. Many of the zooecia are regenerated. It is closely related to *Membranipora perisparsa* Novak, 1877. On our specimen one zooecium with a triple mural rim has twice undergone total regeneration.

*Occurrence.*—Middle Jacksonian: Eutaw Springs, South Carolina (very rare).

*Holotype.*—Cat. No. 63924, U.S.N.M.

### Genus CALLOPORA Gray, 1848.

1848. *Callopora* Gray, List British Animals British Museum, Centroniae, pp. 109, 146.

1903. *Callopora* Norman, Notes on Natural History East Finmark, Annals and Magazine Natural History, ser. 7, vol. 11, p. 588.

Front wall entirely membranous. Marginal walls more or less thickened and crowned with spines, which may be many or few. Ovicell globose, of good size, commonly with a rib across the front. Sessile avicularia with acute mandible at the bottom of the zooecium and above the ovicell or in a lateral position on one or both sides of the oral opening, or in both positions in the same species. Usually two pairs of lateral dietellae and one distal. (Norman.)

*Genotype.*—*Callopora* (*Membranipora*) *lineata* Linnaeus, 1758.

*Range.*—Santonian-Recent.

Nearly all the ovicells are provided in front with an area or more exactly with a callosity more or less granular, formed by the calcareous internal layer of the ovicell.

This definition combines the *Membranipora lineata* group and the *M. tenuirostris* group of Waters, which he defined: "Ovicells with rib; pore chambers usually one distal, four lateral ones; spines round the border. Vicarious avicularia."

In order to separate the two groups generically one would have to be certain that the smaller avicularium of the *M. lineata* group is only interopesial. Unfortunately we have too few specimens to make this study.

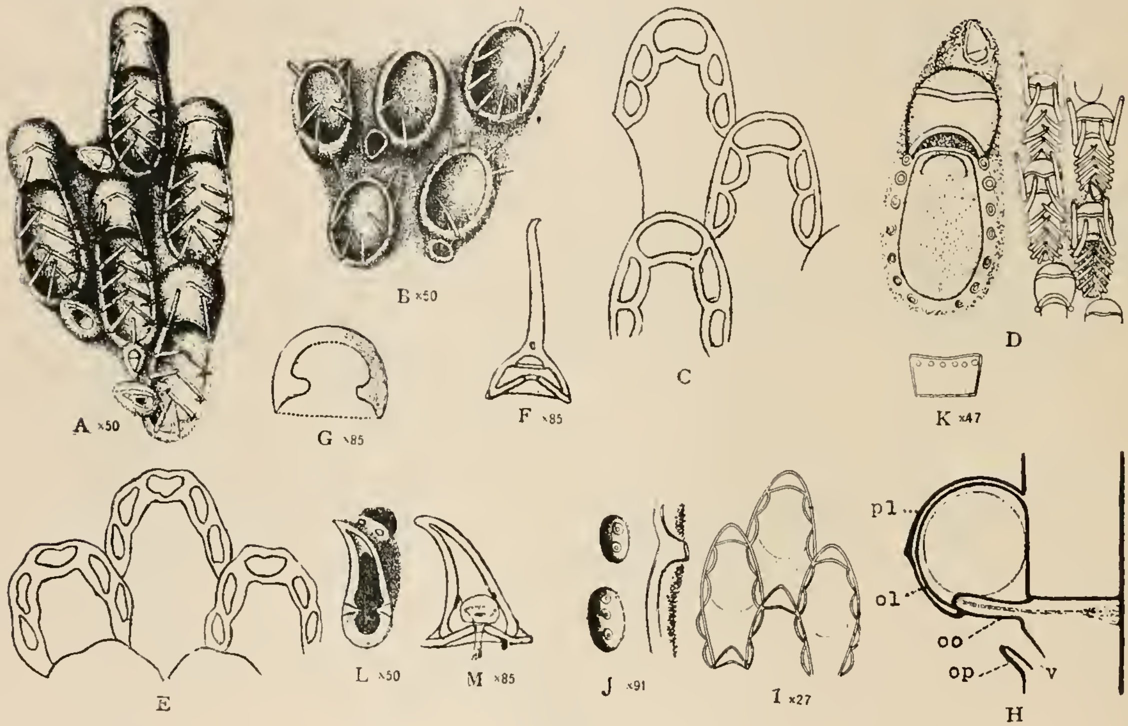

FIG. 37.—Genus *Callopora* Gray, 1848.

A–C. *Callopora lineata* Linnaeus, 1758. A. Zooecia with ovicells and avicularia × 50. B. Ordinary zooecia, × 50. (A, B. After Hincks, 1880.) C. Sketch showing dietellae. (After Norman, 1903.)

D, E. *Callopora craticula* Alder, 1857. D. Several zooecia with ovicells and a single zooecium further enlarged. (After Osburn, 1912.) E. Drawing showing occurrence of the dietellae. (After Norman, 1903.)

F, G. *Callopora tenuirostris* Hincks, 1889. F. Avicularian mandible, × 85. (After Waters, 1885.) G. Operculum × 85. (After Waters, 1898.)

H. *Callopora aurita* Hincks, 1877. Diagrammatic section of ovicell. (After Levinsen, 1909.) *ol*, olocyst; *oo*, ooecial operculum; *op*, operculum; *pl*, pleurocyst; *v*, vestibulum.

I–K. *Callopora dumerilii* Audouin, 1826. I. Sketch showing dietellae × 27. J. Lateral wall showing multiporous septulae, × 91. K. Distal wall with uniporous septulae, × 47. (After Levinsen, 1909.)

L, M. *Callopora curvirostris* Hincks, 1861. L. Avicularium, × 50. M. Avicularian mandible, × 85. (After Waters, 1898, 1885.)

*Callopora* is not only one of the most important genera, but also was one of the earliest to be established. It should not be confused with the Paleozoic bryozoan genus *Callopora* Hall, 1851, for which Bassler has proposed the name *Hallopora.*

The recent species are:

*Callopora (Membranipora) lineata* Linnaeus, 1758.
*Callopora (Membranipora) craticula* Alder, 1857.
*Callopora whiteavesii* Norman, 1903.
*Callopora (Membranipora) nigrans* Hincks, 1882.
*Callopora (Membranipora) aurita* Hincks, 1877.
*Callopora (Membranipora) horrida* Hincks, 1882.
*Callopora (Membranipora) dumerilli* Audouin, 1826.
*Callopora (Membranipora) californiensis* Waters, 1898.
*Callopora (Membranipora) tenuirostris* Hincks, 1880.
*Callopora (Membranipora) curvirostris* Hincks, 1861.
*Callopora (Membranipora) albida* Hincks, 1880.
*Callopora (Membranipora) plana* Hincks, 1880.

The fossil forms are:

*Callopora (Semiflustrina) monilifera* D'Orbigny, 1852.
*Callopora (Semiflustrina) inornata* D'Orbigny, 1852.
*Callopora (Membranipora) invigilata* Brydone, 1910.
*Callopora (Membranipora) britannica* Brydone, 1906.
*Callopora (Membranipora) woodwardi* Brydone, 1906.
*Callopora (Membranipora) coralliformis* Brydone, 1910.
*Callopora (Membranipora) calveti* Canu, 1911.
*Callopora (Membranipora) nordgaardiana*, Canu, 1911.
*Callopora (Pyriporella) ameghinoi* Canu, 1911.
*Callopora (Membranipora) tuberosa* Novak, 1877.
*Callopora (Biflustra) solea* Novak, 1877.
*Callopora (Membranipora) perisparsa* Novak, 1877.
*Callopora (Membranipora) jerseyensis* Ulrich and Bassler, 1907.

## Group of CALLOPORA LINEATA.

### CALLOPORA SEXSPINOSA, new species.

Plate 3, fig. 16.

*Description.*—The zoarium incrusts shells. The zooecia are distinct, separated by a deep furrow, elongated, oval, the point above; the mural rim is salient, rounded, ornamented by six large spines, somewhat wider in its proximal part. The opesium is regular, elliptical or oval. The ovicell is hyperstomial, never closed by the opercular valve, small, globular, salient. Sometimes there is a small avicularium in the interzooecial angles.

*Measurements.*—Opesia $\begin{cases} ho=0.20 \text{ mm.} \\ lo=0.12\text{–}0.14 \text{ mm.} \end{cases}$ Zooecia $\begin{cases} Lz=0.44\text{–}0.50 \text{ mm.} \\ lz=0.30 \text{ mm.} \end{cases}$

*Affinities.*—This species differs from *Callopora tuberosa* in the absence of tuberosities on the mural rim and in the presence of six spines.

It differs from *Callopora crassospina* in the presence of six widely spaced spines instead of twelve.

All of these species form part of the *Ornatella* group of Canu.

*Occurrence.*—Midwayan (Clayton limestone): Brundidge, Alabama (very rare).

*Holotype.*—Cat. No. 63794, U.S.N.M.

### CALLOPORA DUMERILII Audouin, 1826.

Plate 3, fig. 15.

Zoological bibliography.

1826. *Flustra dumerilii* SAVIGNY-AUDOUIN, Explication sommaire des planches de Polypes de l'Egypte et de la Syrie publiées par J. C. Savigny, Paris, pl. 10, fig. 12.

1889. *Membranipora dumerilii* JELLY, A Synonymic Catalogue of Marine Bryozoa, p. 148.

1896. *Membranipora dumerilii* CALVET, Bryozoaires, Résultats scientifique de la Campagne du "Caudan" dans le Golfe de Gascogne, Annales de l'Université de Lyon, vol. 26, p. 253.

1898. *Membranipora dumerilii* WATERS. Observations on Membraniporidae, Journal Linnean Society, London, Zoology, vol. 26, pp. 667–680.

1902. *Membranipora dumerilii* CALVET, Bryozoaires marins des côtes des Corse, Travaux de l'Institut de Zoologie de l'Université de Montpellier, No. 2, Memoire No. 12, p. 13.

1902. *Membranipora dumerilii* CALVET. Bryozoaires marins de la region de Cette, Travaux de l'Institut de Zoologie de l'Université de Montpellier, No. 2, Memoire No. 11, p. 32.

1909. *Callopora dumerilii* LEVINSEN, Morphological and systematic studies on the Cheilostomatous Bryozoa, p. 15, pl. 9, fig. 3.

Paleontological bibliography.

1859. *Membranipora pouilleti* BUSK, A Monograph of the Fossil Polyzoa of the Crag. Publications of the Paleontographical Society, London, vol. 14, p. 32, pl. 3, figs. 4, 5, 6.

1863. *Reptoflustrina biaurieulata* ROEMER. Beschreibung der norddentschen tertiären Polyparien. Paleontographica, vol. 9, Cassel. p. 17, pl. 2, fig. 20.

1866. *Membranipora biauriculata* REUSS, Die Bryozoen des deutschen Septarienthones, Denkschriften des kaiserlichen Akademie der Wissenschaften, Wien, vol 25, p. 171, (55), pl. 8, fig. 6.

1869. *Membranipora lineata* MANZONI, Bryozoi Pliocenici italiani, Sitzungsberichte der kaiserlichen Akademie der Wissenschaften. vol. 59, p. 10, pl. 3, fig. 14 (not pl. 2, fig. 13).

1875. *Membranipora flemingi* MANZONI. I. Bryozoi del pliocene antico di Castrocaro, Bologna, p. 11, pl. 2, fig. 21.

1880. *Membranipora bicornis* SEGUENZA, La formazioni terziare nella Provincia di Reggio (Calabria), Memoires Reale Academia dei Lincei, ser. 3, vol. 6, p. 80, pl. 8, fig. 10. Roma.

1880 *Membranipora pouilleti* SEGUENZA, La formazioni terziare nella Provincia di Reggio (Calabria) Memoires Reale Academia dei Lincei. ser. 3. vol. 6, pp. 80, 197, 328.

1891. *Membranipora dumerilii* WATERS, North Italian Bryozoa. Quarterly Journal of the Geological Society of London, vol. 47, p. 12, pl. 2, fig. 4.

1885. *Membranipora dumerilii* KOSCHINSKY, Ein Beitrag znr Kenntnis der Bryozoenfauna der alteren Tertiarschichten des südlichen Bayerns, Paleontographica, vol. 32. p. 21.

1896. *Membranipora dumerilii* NEVIANI, Briozoi neozoci di alcuna località d'Italia, Bolletino della Societá Romana per gli Studi Zoologici, vol. 5, p. 105, fig. 3.

1901. *Membranipora dumerilii* NEVIANI, Briozoi neogenici delle Calabrie, Palaeontographia italica, vol. 6, p. 158.

1905. *Membranipora dumerilii* NEVIANI, Brozoi fossili di Carrubare (Calabria), Bolletino della Società Geologica Italiana, vol. 23, p. 518, (16), fig. 5.

1912. *Membranipora dumerilii* CANU, Ètnde Comparée des Bryozoaires Helvetiens de l'Egypte. . . . Memoires de l'Institut Egyptien, vol. 6, fasc. 3, pl. 10, fig. 7.

*Description.*—The zoarium incrusts pebbles. The zooecia are short, little distinct, separated by a narrow furrow; the mural rim is thin, projecting but little, convex, enlarged at the base; the opesium is of the same form as the zooecium, a little elliptical or nearly round. The hyperstomial ovicell, never closed by an opercular valve, is globular and projecting; it is ornamented with a frontal callosity, finely granular. There are two small avicularia at the base of each zooecium; they are salient, triangular, and symmetrical.

*Measurements.*—Opesia $\left\{\begin{array}{l} ho=0.25 \text{ mm.} \\ lo=0.15 \text{ mm.} \end{array}\right.$ Zooecia $\left\{\begin{array}{l} Lz=0.35\text{–}0.40 \text{ mm.} \\ lz=0.25 \text{ mm.} \end{array}\right.$

*Occurrence.*—Midwayan (Clayton limestone): Brundidge, Alabama (very rare).

*Geological distribution.*—Lutetian of Bavaria (Koschinsky): Priabonian of Vicentin (Waters); Stampian of Germany (Roemer, Reuss); Burdigalian of Gard and of Herault in France (Collection Canu); Helvetian of Italy (Seguenza), of Gard and of Herault (Collection Canu); Zanclean of Italy (Seguenza); Plaisancian of England (Busk), of Italy (Manzoni); Sicilian of Italy (Sequenza, Neviani); Quaternary of Italy (Manzoni, Neviani); Miocene of New Zealand (Waters).

*Habitat.*—Eastern Atlantic from Madeira to Scandinavia. Mediterranean and Adriatic. Dredged at about 150 meters, it lives chiefly from 10 to 40 meters.

It is to be noted that the recent fauna of Madeira presents much relationship to that of Florida.

*Plesiotype.*—Cat. No. 63793. U.S.N.M.

### CALLOPORA DUMERILII LATA, new variety.

Plate 29, fig. 6.

Our determination of this recent species in a horizon so low is the more remarkable because in our large amount of material we have been able to discover only a few specimens at Wilmington, much more distinct from the type and for which we are obliged to make a new variety.

*Measurements.*—Opesia $\left\{\begin{array}{l} ho=0.24 \text{ mm.} \\ lo=0.24\text{–}0.26 \text{ mm.} \end{array}\right.$ Zooecia $\left\{\begin{array}{l} Lz=0.30 \text{ mm.} \\ lz=0.28 \text{ mm.} \end{array}\right.$

A certain number of zooecia have only a single avicularium placed in front of the opesium as in the genus *Ramphonotus*. On our specimens there is not a single opesium resembling its neighbor. In general the elongated zooecia are less common. For this reason we have believed that the American Jacksonian specimens ought to be separated as a variety. The differences from the recent type-species are slight, only the larger size of the opesia measuring 0.24 to 0.26 mm. instead of 0.20 mm., being an insignificant difference, for which reason it is useless to create a new species. Moreover, there is almost a complete identity between our photographs and the varieties of *Membranipora dumerilii* figured by Busk.[1]

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[1] Crag Polyzoa, 1859, pl. 3, fig. 4.

*Occurrence.*—Middle Jacksonian (Castle Hayne limestone): Wilmington, North Carolina (very rare).

*Holotype.*—Cat. No. 63923, U.S.N.M.

### CALLOPORA FILOPARIETIS, new species.

Plate 29, fig. 4.

*Description.*—The zoarium incrusts pebbles and Cellepores. The zooecia are elongated, distinct, elliptical, variable; the mural rim is very thin, *filiform*, salient, convex. The opesium is entire, medium, and of the same form as the zooecia. The ovicell is hyperstomial, never closed by the opercular valve, smooth, salient, transverse. The avicularia are small, very pointed, nearly perpendicular to the zoarial plane appearing to be interjected between the opesia.

*Measurements.*—Opesia $\left\{\begin{array}{l} ho=0.40\text{–}0.45 \text{ mm.} \\ lo=0.26 \text{ mm.} \end{array}\right.$ Ovicells $\left\{\begin{array}{l} hov=0.15 \text{ mm.} \\ lov=0.20 \text{ mm.} \end{array}\right.$

*Affinities.*—This species differs from the recent *Membranipora macilenta* Jullien, 1882, in which the walls are very thin, by its much smaller micrometric dimensions and in the form of its mural rim.

The species having thin mural rims are not rare; they can be determined readily only if they bear ovicells and avicularia.

*Occurrence.*—Lower Jacksonian (Moodys marl): Jackson, Mississippi (rare).

*Holotype.*—Cat. No. 63921, U.S.N.M.

### CALLOPORA INGENS, new species.

Plate 29, fig. 3.

*Description.*—The zoarium incrusts rocks. The zooecia are elongated, little distinct. separated by a very small furrow, nearly hexagonal; the mural rim is but little salient, convex, thin at the top, enlarged below, finely granulated; the opesium is elliptical and finely crenulated. The hyperstomial ovicell is small, globular and projects considerably. The avicularium is very small, salient, oblique, the point below.

*Measurements.*—Opesia $\left\{\begin{array}{l} ho=0.40\text{–}0.44 \text{ mm} \\ lo=0.24 \text{ mm.} \end{array}\right.$ Zooecia $\left\{\begin{array}{l} Lz=0.56\text{–}0.60 \text{ mm.} \\ lz=0.40 \text{ mm.} \end{array}\right.$

*Affinities.*—The avicularium is placed in a small triangular, interopesial cavity, the walls of which are often distinct.

This species bears considerable resemblance to *Callopora dumerilii* Audouin, 1826. differing from it only in its much *larger* dimensions and the inconstancy of its small avicularia.

*Occurrence.*—Lower Jacksonian (Moodys marl): Jackson, Mississippi (very rare).

*Holotype.*—Cat. No. 63920, U.S.N.M.

### CALLOPORA CRASSOSPINA, new species.

Plate 29, fig. 9.

*Description.*—The zoarium incrusts rocks. The zooecia are elongated, distinct, regularly elliptical, provided with a small gymnocyst; the mural rim is convex, very salient, ornamented with a line of *large spines*. The opesium is elliptical, entire. The hyperstomial ovicell, never closed by the opercular valve, is globular, projecting, and ornamented with a longitudinal carina. The avicularium is large, placed transversally to the zooecial axis, very pointed, and has two denticles serving as a pivot.

*Measurements.*—Opesia $\left\{\begin{array}{l} ho=0.32 \text{ mm.} \\ lo=0.22 \text{ mm.} \end{array}\right.$ Zooecia $\left\{\begin{array}{l} Lz=0.40 \text{ mm.} \\ lz=0.30 \text{ mm.} \end{array}\right.$

*Affinities.*—The avicularia are so scattered over the zoarium that most of the zooecia are not provided with them. At first view this species strangely resembles *Membranipora incrustans* Waters, 1898. It differs from it, however, in its larger avicularium, its larger spines, and in its ovicell which is hyperstomial and not endozooecial. This is only another example in favor of the very great prudence which it is necessary to employ in the determination of the Membranipores.

*Callopora crassospina* differs from the recent *Callopora craticula* Hincks, 1877, in its transverse avicularia and its greater zooecial length.

*Occurrence.*—Middle Jacksonian (Castle Hayne limestone): Wilmington, North Carolina (rare).

*Holotype.*—Cat. No. 63926, U.S.N.M.

### CALLOPORA CONVEXA, new species.

Plate 29, fig. 8.

*Description.*—The zoarium is unilamellar and creeps on algae. The zooecia are distinct, separated by an oval furrow, narrowed in their proximal portion; the lower part is a more or less developed gymnocyst, smooth and *convex;* the mural rim is very thin with a sharp summit. The opesium is elongated, elliptical, or somewhat oval. The ovicell is hyperstomial, small, globular. Sometimes there is an elongated avicularium with pointed beak.

*Measurements.*—Opesia $\left\{\begin{array}{l} ho=0.30\text{–}0.34 \text{ mm.} \\ lo=0.25 \text{ mm.} \end{array}\right.$ Zooecia $\left\{\begin{array}{l} Lz=0.50\text{–}0.75 \text{ mm.} \\ lz=0.35\text{–}0.40 \text{ mm.} \end{array}\right.$

*Affinities.*—Only a few specimens of this species have been found; nevertheless, they have appeared very interesting to us. We are not quite certain that the opercular valve never closes the ovicell. We are not able to classify the species in *Membraniporidra* in which the zooecial form is often analogous, because of the presence of avicularia.

The convex form of the zooecia and of the gymnocyst characterizes this species quite well.

*Occurrence.*—Middle Jacksonian (Castle Hayne limestone): Wilmington, North Carolina (rare).

*Holotype.*—Cat. No. 63925, U.S.N.M.

### CALLOPORA AURITA Hincks, 1877.

Plate 29, fig. 2.

1877. *Membranipora aurita* Hincks, On British Polyzoa, Annals and Magazine Natural History, ser. 4, vol. 20, p. 213.

1880. *Membranipora aurita* Hincks, British Marine Polyzoa, p. 159, pl. 21, figs. 5, 6.

1894. *Membranipora aurita* Levinsen, Mosdyr. Zoologica Danica, Hefte 9, p. 59, pl. 4, figs. 31–38.

1902. *Membranipora aurita* Calvet, Bryozoaires des côtes de Corse, Travaux de l'Institut de Zoologie de l'Université de Montpellier, ser. 2, Memoire 12, p. 34.

1909. *Membranipora aurita* Levinsen, Morphological and Systematic Studies on the Cheilostomatous Bryozoa, p. 150, pl. 9, fig. 4.

1912. *Membranipora aurita* Osburn, The Bryozoa of the Woods Hole Region, Bulletin Bureau Fisheries, vol. 30, p. 230, pl. 23, fig. 37.

*Measurements.*—Opesia $\begin{cases} ho=0.20\text{–}0.25\text{ mm.} \\ lo=0.10\text{ mm.} \end{cases}$ Zooecia $\begin{cases} Lz=0.25\text{ mm.} \\ lz-0.17\text{ mm.} \end{cases}$

*Affinities.*—Only the single figured specimen has been found and unfortunately it is incomplete. The frontal of the ovicells is destroyed and the avicularia are inconstant. We think, however, that our determination of the species is correct. Our specimen is tubular, as it grew about a small alga at a bifurcation. Concerning this method of growth, Osburn wrote: "Zoarium incrusting, usually on shell, but often on algae . . . on the stems of algae the zooecia are generally irregular and the cells sometimes crowded."

The zooecial micrometric dimensions correspond exactly with those in Levinsen's figure. The opesial dimensions are very close to those which may be measured on the figure given by Hincks.

In the vicinity of the two areal spines there is a contraction of the opesium. The same characteristic may be observed in Osburn's figure.

On many zooecia we have observed small avicularia in the same position as shown in the published figures, but they are not constant. They appear a little larger in the lateral portions of the zoarium. It thus appears very difficult to find any important differences between this fossil form and the recent *Membranipora aurita* Hincks.

This species has hitherto never been found in the fossil state, and indeed, it was only recently discovered by Osburn in the West Atlantic.

*Occurrence.*—Middle Jacksonian (Castle Hayne limestone): Wilmington, North Carolina (very rare).

*Habitat.*—North Sea: Off England and Denmark in the English Channel. Mediterranean. Eastern Atlantic: Azore Islands. West Atlantic off the coast of the United States.

It lives at depths from 5 to 34 meters. However, at the Azores it has been dredged at a depth of 130 meters.

*Plesiotype.*—Cat. No. 63919, U.S.N.M

## Group of CALLOPORA TENUIROSTRIS.

### CALLOPORA CUCULLATA, new species.

Plate 14, fig. 1.

*Description.*—The zoarium incrusts a species of *Idmonea.* The zooecia are elongated, distinct, elliptical; the mural rim is salient, flat, granular, very thin at the top, enlarged below. The opesium is elliptical. The hyperstomial ovicell never closed by the opercular valve, globular, and salient, exhibits a frontal triangular area of greater or less size. The avicularia are interzooecial. dispersed over the zoarium, large, without pivot. and quite acuminate.

*Measurements.*—Opesia $\begin{cases} ho=0.20\text{–}0.24 \text{ mm.} \\ lo=0.16 \text{ mm.} \end{cases}$ Zooecia $\begin{cases} Lz=0.32\text{–}0.36 \text{ mm.} \\ lz=0.20 \text{ mm.} \end{cases}$

Avicularia $\begin{cases} Lav=0.30\text{–}0.36 \text{ mm.} \\ lav=0.16 \text{ mm.} \end{cases}$ Ovicells $\begin{cases} hov=0.14 \text{ mm.} \\ lov=0.08 \text{ mm.} \end{cases}$

*Affinities.*—The ovicell is formed of two calcareous lamellae; the interior lamella is formed of an olocyst identical with the olocyst of the mural rim; the superior lamella is a cover like a hood but incomplete and leaves the triangular area referred to above. The size of this area is quite variable.

In its ovicell this species resembles *Callopora aurita* Hincks, 1877, considerably, but it differs in its greater zooecial length, and its interzooecial avicularia are as long as the zooecia themselves.

*Callopora cucullata* differs from *C. tenuirostris* Hincks, 1880, in the triangular area of its ovicell and in its smaller dimensions.

*Occurrence.*—Lower Jacksonian: 3½ miles southeast of Shell Bluff post office, Georgia (very rare).

*Holotype.*—Cat. No. 63849, U.S.N.M.

### CALLOPORA STIPATA, new species.

Plate 4, fig. 1.

*Description.*—The zoarium incrusts shells. The zooecia are elongated, distinct. separated by a deep furrow; the mural rim is flat, very finely striated, much enlarged at the base; the gymnocyst is very small and inconstant; the opesium is oval, very finely denticulated. The ovicell is small, globular, smooth, salient. The interzooecial avicularia are large, very elongated, fusiform or elliptical with two lateral denticles.

*Measurements.*—Opesium $\begin{cases} ho=0.18 \text{ mm.} \\ lo=0.13 \text{ mm.} \end{cases}$ Zooecia $\begin{cases} Lz=0.30\text{–}0.36 \text{ mm.} \\ lz=0.18 \text{ mm.} \end{cases}$

Avicularia $\begin{cases} Lav=0.24\text{–}0.36 \text{ mm.} \\ lav=0.12 \text{ mm.} \end{cases}$

*Affinities.*—This species is very characteristic. The avicularia are grouped in distinct but irregular lines; they appear to safeguard the zooecia which they often entirely surround.

*Occurrence.*—Midwayan (Clayton limestone): Well at Brundidge, Alabama (very rare).

*Holotype.*—Cat. No. 63795, U.S.N.M.

### CALLOPORA TENUIROSTRIS Hincks, 1880.

Plate 29, figs. 10. 11.

1879. *Membranipora Flemingi* Waters. On the Bryozoa of the Bay of Naples, Annals and Magazine of Natural History, ser. 5, vol. 3, p. 122, pl. 13, fig. 2.
1880. *Membranipora tenuirostris*, Hincks, General History of the Marine Polyzoa, I. Madeiran Polyzoa, Annals and Magazine of Natural History, ser. 5, vol. 6, p. 70, pl. 9, fig. 3.
1885. *Membranipora tenuirostris* Waters, On the use of the avicularian mandible in the determination of Cheilostomatous Bryozoa, Journal Royal Microscopical Society, ser. 2, vol. 5, p. 14, fig. 41.
1887. *Membranipora tenuirostris* Hincks, Polyzoa of the Adriatic, Annals and Magazine of Natural History, ser. 5, vol. 19, p. 314.
1891. *Membranipora tenuirostris* Waters, North Italian Bryozoa, Quarterly Journal of the Geological Society of London, vol. 47, p. 11.
1898. *Membranipora tenuirostris* Waters, Observations on Membraniporidae, Journal Linnean Society, London, Zoology, vol. 26, p. 685, pl. 47, fig. 7.
1909. *Crassimarginatella tenuirostris* Norman, The Polyzoa of Madeira and neighboring islands, Journal Linnean Society, London, Zoology, vol. 30, p. 288.

*Measurements.*—Opesia $\left\{\begin{array}{l} ho=0.25\text{–}0.30\text{ mm.}\\ lo=0.15\text{ mm.}\end{array}\right.$ Zooecia $\left\{\begin{array}{l} Lz=0.40\text{–}0.45\text{ mm.}\\ lz=0.20\text{–}0.25\text{ mm.}\end{array}\right.$

Norman has classified in the *Crassimarginata* group all of the Membranipores having an interzooecial avicularium without consideration of the function of the opercular valve which closes the ovicell in *Grammella crassimarginata* Hincks. The *Crassimarginata* group and *Tenuirostris* group are therefore quite distinct as Waters has clearly shown in 1898.

The frontal callosity of the ovicell is due to the incomplete development of the upper calcareous layer (probably a pleurocyst).

This species seems quite variable. From dredgings at Oran (Algeria) two sorts of specimens have been obtained which from all their characters may be classed as this species. The first is large and vigorous, the zooecial dimensions being 0.40 mm. by 0.60 mm. An analogous variation exists in the classic Helvetian faluns of Touraine. The others are smaller and measure 0.40 by 0.30 mm., dimensions which correspond to those in Waters's figure and which ought to be considered as normal. Our specimens are simply a little narrower.

The occurrence of this species as a fossil in America is entirely natural. It lives at the present time at Madeira where the fauna is close to that of the Gulf of Mexico. It has been found fossil in the Priabonian of Vicentin which is about the horizon of the American Jacksonian.

Figure 11 seems to represent the same species in the vicinity of the ancestrula, indeed only the avicularia are a little different.

*Occurrence.*—Lower Jacksonian (Moodys marl): Jackson, Mississippi (rare).

*Habitat.*—Mediterranean and Adriatic. East Atlantic: Madeira Islands. East Pacific: Queen Charlotte Islands. At Naples, the species lives at depths ranging from 0 to 64 meters.

*Geological distribution.*—Priabonian of Vicentin (Waters); Helvetian of Touraine (collection Canu).

*Plesiotypes.*—Cat. No. 63927, U.S.N.M.

### CALLOPORA VICINA, new species.

Plate 81, figs. 2, 3.

*Description.*—The zoarium incrusts bryozoa. The zooecia are elongated, distinct, elliptical, or oval; the mural rim is quite salient, flat, very finely granular. The opesium is of the same form as the zooecium. The avicularia are distributed irregularly over the zoarium between the opesia; they are oblique and their anterior part is embedded in the mural rim, whereas their point projects considerably above the latter.

*Measurements.*—Opesia $\begin{cases} ho=0.30 \text{ mm.} \\ lo=0.16 \text{ mm.} \end{cases}$ Zooecia $\begin{cases} Lz=0.40 \text{ mm.} \\ lz=0.26 \text{ mm.} \end{cases}$

*Variations.*—The mural rim is rarely regular; more often it is a little enlarged at the base. The avicularia often exhibit two lateral denticles serving as a pivot for the mandible which can thus easily be placed between the mural rims, which are always separated by a deep furrow. On our specimens there are numerous zooecia with double mural rims, which have undergone total regeneration.

*Affinities.*—This species is really close to *Callopora tenuirostris* Hincks, 1880, but differs from it in its much smaller avicularia. It appears to be intermediate between the *Callopora lineata* group and the *C. tenuirostris* group.

*Occurrence.*—Vicksburgian ("Chimney rock" of Marianna limestone): One mile north of Monroeville, Alabama (common).

*Cotypes.*—Cat. No. 64234, U.S.N.M.

### CALLOPORA (?) TUBEROSA, new species.

Plate 3, fig. 14.

*Description.*—The zoarium is free, unilamellar. The zooecia are little distinct, subcircular; the mural rim is salient, very thick, convex, and bears 6 to 8 large *tuberosities* entire or hollow. The opesium is oval, a little crenulated. The ovicell is hyperstomial. On the gymnocyst there are one or two large, projecting avicularia in which the orifice, turned toward the opesium, is perpendicular to the zooecial plane and consequently hardly visible. Between the zooecia there are long, thin avicularia without a pivot.

*Affinities.*—This species is quite an unusual form and we have been unable to make a detailed study of it because the figured specimen is the only one known. Some of the interzooecial avicularia have a resemblance to *Holoporella decostilsii* Audouin, 1826, but are provided with a pivot.

*Occurrence.*—Midwayan (Clayton limestone): One mile west of Fort Gaines, Georgia (very rare).

*Holotype.*—Cat. No. 63792, U.S.N.M.

### CALLOPORA MUNDULA, new species.

Plate 29, fig. 12.

*Description.*—The zoarium is bilamellar, free, composed of large, flat fronds; the two lamellae are back to back and inseparable. The zooecia are large, elongated, distinct, separated by a deep furrow; the mural rim is thin distally, enlarged proximally, rounded or angular. The opesium is regular, elliptical, elongated. The ovicell is globular, salient, smooth; it is hyperstomial and opened in a special orifice above the operculum. The avicularium is frontal, large, elliptical with two lateral denticles.

*Measurements.*—Opesia $\begin{cases} ho=0.55 \text{ mm.} \\ lo=0.28 \text{ mm.} \end{cases}$ Zooecia $\begin{cases} Lz=0.75\text{–}1.00 \text{ mm.} \\ lz=0.35\text{–}0.40 \text{ mm.} \end{cases}$

*Affinities.*—This *neat* and elegant species appears to be the largest species of *Callopora.* In general aspect it approaches *Grammella transversa;* it differs from it in the longitudinal and non-transverse orientation of its avicularium and its bifoliate and not incrusting zoarium.

*Occurrence.*—Lower Jacksonian (Moodys marl): Jackson, Mississippi (rare).

*Holotype.*—Cat. No. 63928, U.S.N.M.

### Genus AMPHIBLESTRUM Gray, 1848.

1848. *Amphiblestrum* GRAY, List British Animals British Museum, Centroniae, pp. 110, 146.

1903. *Amphiblestrum* NORMAN, Notes Natural History East Finmark, Annals and Magazine Natural History, ser. 7, vol. 11, p. 596.

Hinder portion of the area covered with a calcareous crust. In front of this a considerable portion of the area, typically trifoliate, but sometimes semielliptical or subrotund, is covered only by a thin membrane, at the distal extremity of which is situated the simple oral opening. Margin of zooecium thickened, often granulated, sometimes bearing a pair (or more) of lateral spines found in young specimens. Reproduction by means of prominent hyperstomial ovicells never closed by the operculum. Sessile avicularia often present, sometimes one, sometimes two, on the hinder portion of the zooecium. Dietellae, two pairs of lateral and one distal. (After Norman.)

*Genotype.*—*Amphiblestrum* (*Membranipora*) *flemingii* Busk, 1852.

*Range.*—Senonian-Recent.

This is in part the *Membranipora flemingii* group of Waters which he defined as follows: "Ovicells with more or less arched area on the front; usually lamina over considerable part of the front. Pore chambers."

The opesium often appears trifoliate. The distal part is occupied by the opercular valve for which the opesial contraction serves as a pivot. The proximal portion, which is the larger, is occupied by the chitinous part of the cryptocyst on which the parietal muscles are inserted. The calcareous cryptocyst, the chitinous cryptocyst, and the opercular valve form a structure in direct contact with the ectocyst. The entire structure is covered by a thin ectocyst united at the opercular valve which is thus thickened and often bordered with a sclerite. Between the chitinous cryptocyst and the ectocyst is the hypostege or hydrostatic zooecial chamber. We do not yet know whether the hypostege contains sea water as in the compensation sack of other Cheilostomata or was filled with the fluid of the general body cavity.

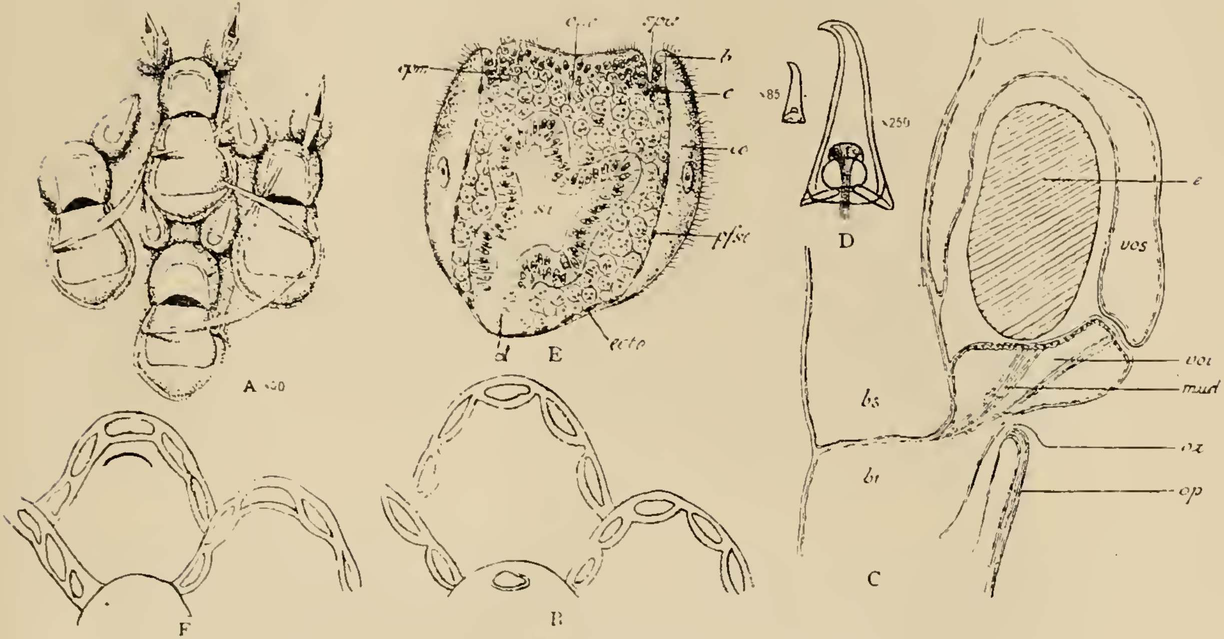

FIG. 38.—Genus *Amphiblestrum* Gray, 1848.

A–E. *Amphiblestrum flemingii* Busk, 1825. A. Zooecia, × 50 (after Hincks, 1880). B. Sketch showing dietelle (after Norman, 1903.) C. Section in the ovicell (after Calvet, 1900).

*bi*, inferior bryozooid.
*bs*, superior bryozooid.
*co*, coronna.
*c*, embryo.
*mud*, dilator muscle of incubation cavity.
*op*, operculum.
*oz*, zooecial orifice.
*si*, internal sack.
*voi*, inferior ovicell vesicle.
*vos*, superior ovicell vesicle.

D. Avicularian mandible, × 85 and × 250 (after Waters, 1885).

E. Meridian section following a plane perpendicular to the median sagittal plane in an embryo almost completely developed (after Calvet, 1900).

*b*, cellules of the upper vesicular collar.
*c*, mantle.
*d*, tampon of the internal sac;
*epm*, mesoderm thickening.
*ecto*, oral ectoderm.
*onc*, central nervous organ of the embryo.
*pfse*, sub-ectodermal nerve plexus.
*spa*, palial furrow.

F. *Amphiblestrum trifolium* Wood, 1850. Sketch showing dietellae (after Norman, 1903).

This organization is therefore identical with that of the Electrinidae, of the other Membraniporae, of the Flustridae, etc. The only difference is that the cryptocyst, being partially calcified, can be observed more easily. One consequence of this calcification is that the parietal muscles are observable only in the distal part of the zooecia.

The ovicell is widely open above the operculum. It is formed of two calcareous lamellae, the upper of which being incomplete, limits the frontal area or callosity as in the genus *Callopora* Gray, 1848. But we insist it is also entirely covered by the membranous ectocyst, quite as in all the other Cheilostomata.

The relations of this genus with *Callopora* are very great. In the latter the avicularia are also interopesial or interzooecial, and they have the same form and arrangement. The rarity of the spines and the partial calcification of the cryptocyst are the only characters of differentiation.

The recent species belonging to the genus are:

*Amphiblestrum* (*Membranipora*) *flemingii* Busk, 1852.
*Amphiblestrum* (*Membranipora*) *trifolium* Wood, 1850.
*Amphiblestrum* (*Membranipora*) *argentea* MacGillivray, 1868.
*Amphiblestrum* (*Membranipora*) *umbonata* Busk, 1852.

The fossil species are:

*Amphiblestrum* (*Reptoflustrella*) *heteropora* Gabb and Horn, 1862.
*Amphiblestrum* (*Membranipora*) *anterides* Brydone, 1910.
*Amphiblestrum harmeri* Canu, 1911.
*Amphiblestrum coriense* MacGillivray, 1895.

### AMPHIBLESTRUM HETEROPORA Gabb and Horn, 1862.

Plate 1, figs. 11–13.

1862. *Reptoflustrella heteropora* GABB and HORN, Monograph of the Fossil Polyzoa of the Secondary and Tertiary formations of North America, Journal of the Academy of Natural Sciences of Philadelphia, ser. 2, vol. 5, p. 12, pl. 20, fig. 50.

1901. *Reptoflustrella heteropora* ULRICH, Maryland Geological Survey, Eocene, pp. 213–214, pl. 60, figs. 8, 9.

1907. *Amphiblestrum heteropora* WELLER, Geological Survey of New Jersey, Paleontology, vol. 4, p. 333, pl. 23, figs. 14–16.

*Description.*—Colony incrusting in irregular patches. Cellules in a single layer, placed with but little regularity, but with a tendency to radiating lines; elongate, acuminate anteriorly, broadly truncate behind. Opening subtriangular, with the sides convex, often approaching an oval in very long cellules. Surface regularly convex, bordered anteriorly and laterally by a slightly elevated, rounded edge, usually becoming obsolete as it approaches the proximal end of the cellule. Special pore placed in advance of the opening, small and round. No ovarian vesicles were observed. Old cellules are closed over by a continuation of the surface wall totally obliterating the aperture. In this case the "special pore" is also generally obliterated, merely showing a slight depression. (Gabb and Horn, 1862.)

The Eocene specimens are coarser in appearance than the Cretaceous form of the species, of which the writer has a number of excellent examples. They differ further in the more pronounced character of the granulation of the front wall and opesial margin, the Cretaceous form being almost smooth; in more frequently assuming a rhomboidal form of zooecium; and in the relatively smaller size of the opesium and larger avicularia. Cucullate ooecia, less prominent but otherwise similar to those of *Membranipora spiculosa*, occur not infrequently upon the Cretaceous specimens but are wanting on the Eocene material in hand. When these occur they take the place of the avicularium which otherwise occurs invariably on, or just above, the upper rim of the zooecium. (Ulrich. 1901.)

*Occurrence.*—Cretaceous (Vincentown): Mullica Hill and Vincentown, New Jersey (common).

Lowest Eocene (Bryozoan bed at base of Aquia formation): Upper Marlboro, Maryland (rare).

### AMPHIBLESTRUM PRODUCTUM, new species.

Plate 4, figs. 2, 3.

*Description.*—The zoarium incrusts rocks and shells. The zooecia are small, very *elongated*, distinct, often with a small gymnocyst; the mural rim is salient, being enlarged below into a concave cryptocyst nearly as long as the opesium. The opesium is small, anterior, elliptical, entire. The hyperstomial ovicell, never closed by the operculum, is elongated, very salient, and has a frontal carina. The avicularia are narrow, long, fusiform, pointed, and slightly projecting at the top, without pivot.

*Measurements.*—Opesia $\left\{\begin{array}{l} ho=0.15 \text{ mm.} \\ lo=0.10\text{–}0.12 \text{ mm.} \end{array}\right.$ Zooecia $\left\{\begin{array}{l} Lz=0.35 \text{ mm.} \\ lz=0.20\text{–}0.25 \text{ mm.} \end{array}\right.$

Avicularia $Lav=0.20\text{–}0.25$ mm.

*Variations, affinities.*—The length of the avicularia is very variable: they are frequently primoserial; their mandible must be triangular. The ovicell has no callosity, but is ornamented with a longitudinal keel. This change in ornament has no generic importance.

The zooecia have a little resemblance to *Amphiblestrum curvatum*, but the present species differs from the latter in its straight avicularia.

*Occurrence.*—Midwayan (Clayton limestone): One mile west of Fort Gaines, Georgia (rare); Luverne, Crenshaw County, Alabama (rare).

*Cotypes.*—Cat. Nos. 63796, 63797, U.S.N.M.

### AMPHIBLESTRUM BIPOROSUM, new species.

Plate 29, figs. 13, 14.

The zoarium incrusts shells. The zooecia are small, wide, pyriform, and distinct; the cryptocyst is concave and as long as the opesium. The opesium is anterior, somewhat trifoliate. The ovicell is hyperstomial and never closed by the operculum. Below each zooecium there are two small simple avicularia, slightly projecting, round or elliptical, irregularly placed, leaving *two pores* on the fossils.

*Measurements.*—Opesia $\left\{\begin{array}{l} ho=0.15 \text{ mm.} \\ lo=0.10 \text{ mm.} \end{array}\right.$ Zooecia $\left\{\begin{array}{l} Lz=0.30\text{–}0.32 \text{ mm.} \\ lz=0.25 \text{ mm.} \end{array}\right.$

*Affinities.*—The cryptocyst is formed simply by the progressive enlargement of the mural rim. This species has the aspect of *Dacryonella octonarium* but differs from it in its hyperstomial ovicell. It is the only species of *Amphiblestrum* provided with round avicularia.

*Occurrence.*—Middle Jacksonian: Lenuds Ferry, South Carolina (very rare).

*Holotype.*—Cat. No. 63929, U.S.N.M.

### AMPHIBLESTRUM FLAMMEUM, new species.

Plate 29, fig. 15.

The zoarium incrusts rocks. The zooecia are elongated, distinct, distended, and have a small narrow cryptocyst; the mural rim is thin, salient, complete, encompassing a concave cryptocyst shorter than the opesium. The opesium is oval or elliptical. The ovicell is globular, salient, hyperstomial, never closed by the operculum. The avicularia are interzooecial, much elongated, thin, and sinous in front like a *flame*, with a very small canal serving to lodge the mandible.

*Measurements.*—Opesia $\left\{\begin{array}{l} ho=0.20\text{–}0.25 \text{ mm.} \\ lo=0.15\text{–}0.20 \text{ mm.} \end{array}\right.$ Zooecia $\left\{\begin{array}{l} Lz=0.50\text{–}0.60 \text{ mm.} \\ lz=0.30\text{–}0.35 \text{ mm.} \end{array}\right.$

Avicularia $\left\{\begin{array}{l} Lav=0.40 \text{ mm.} \\ lav=0.15 \text{ mm.} \end{array}\right.$

*Affinities.*—The cryptocyst is very variable in this species; some zooecia are unprovided with one and resemble those of *Callopora* Gray, 1848. The relations between this genus and *Amphiblestrum* Gray, 1848, are recognized as having been very close.

The ovicell on our specimens is ornamented with neither a keel nor a callosity. The affinities of this species with *Callopora tenuirostris* Hincks, 1880, are very great, but it differs from the latter in the presence of a cryptocyst in the much smaller orifice of the avicularium and in the much larger zooecium.

It differs from *Amphiblestrum patens* in the absence of a gymnocyst, in the complete mural rim and in a long distal canal in the avicularium.

*Occurrence.*—Middle Jacksonian (Castle Hayne limestone): Wilmington, North Carolina (rare).

*Holotype.*—Cat. No. 63930, U.S.N.M.

### AMPHIBLESTRUM PATENS, new species.

Plate 30, figs. 1–3.

The zoarium incrusts shells. The zooecia are distinct, slightly elongated, wide, often having a small gymnocyst; the mural rim is enlarged laterally and incomplete proximally; the cryptocyst is a little concave, distinct from the mural rim, granular. The opesium is terminal, elongated, oval, finely crenulated, with a straight proximal border. The ovicell is hyperstomial, never closed by the operculum. The avicularia are interzooecial, elongated, fusiform, *wide*, with a short distal, small canal; the pivot is formed by two lateral denticles. The ancestrula is a small, ordinary zooecium.

*Measurements*—Opesia $\begin{cases} ho=0.20 \text{ mm.} \\ lo=0.16 \text{ mm.} \end{cases}$ Zooecia $\begin{cases} Lz=0.40\text{–}0.45 \text{ mm.} \\ lz=0.35 \text{ mm.} \end{cases}$

Avicularia $\begin{cases} Lar=0.35 \text{ mm.} \\ lar=0.20\text{–}0.25 \text{ mm.} \end{cases}$

*Affinities.*—The presence of the gymnocyst modifies the zooecial length very much, and it is not rare to observe zooecia 0.60 mm. in length. The difference between this form and *A. flammeum* is small; the mural rim is not complete and the larger avicularium is terminated only by a beak having a small narrow canal.

Many zooecia have no cryptocyst and these have considerable resemblance to *Callopora tenuirostris* Hincks, 1880, but this variety is not common enough to cause errors in identification. Figure 3 on plate 30 is of a specimen altered chemically. Figure 2 is perhaps of this species representing the region of the ancestrula.

*Occurrence.*—Upper Jacksonian (Ocala limestone): Old Factory, 1½ miles above Bainbridge, Georgia (very rare); 4 miles below Bainbridge, Georgia (very rare); 7 miles above Bainbridge, Georgia (very rare); Bainbridge, Georgia (very rare).

*Cotypes.*—Cat. No. 63931, U.S.N.M.

### AMPHIBLESTRUM ORBICULATUM, new species.

Plate 30, fig. 4.

*Description.*—The zoarium incrusts shells. The zooecia are distinct, little elongated, suborbicular, separated by a deep furrow; they are surrounded by a small gymnocyst; the mural rim is thin and salient; the cryptocyst is flat, orbicular, perforated with very scattered tremopores. The opesium is semilunar, surrounded by a salient peristome, the distal part of which bears from 4 to 6 spines. The ovicell is hyperstomial, globular and salient; it opens above the operculum by a special orifice. The small avicularia are rare, interzooecial, and triangular. There are two pairs of lateral dietellae.

*Measurements.*—Opesia $\begin{cases} ho=0.05 \text{ mm.} \\ lo=0.07 \text{ mm.} \end{cases}$ Zooecia $\begin{cases} Lz=0.35\text{–}0.40 \text{ mm.} \\ lz=0.32\text{–}0.35 \text{ mm.} \end{cases}$

*Affinities.*—The genus *Thairopora* was proposed by MacGillivray in 1890 for the species provided with a calcified cryptocyst and with an operculum corresponding to the opesium. This is precisely the case in our American species where the opesium is transformed into a real aperture. But the species of *Thairopora* have some characters entirely different, such as interzooecial avicularia, internal spicules, and labial processes. We are therefore unable to classify this American species in that genus.

In its external aspect this species resembles a *Micropora*, but it differs from that genus in its hyperstomial, not endozooecial ovicell, and in the absence of opesiules.

In the ensemble of its characters, interopesial avicularia, oral spines, hyperstomial ovicell, this is surely an *Amphiblestrum*, of which it forms a very divergent type on account of the transformation of the opesium into an aperture and of the opercular valve into a true operculum.

Within the broken ovicells there are spines. This is an absolute impossibility. One must therefore suppose that the spines are reformed after the destruction of the ovicell. This destruction is frequent everywhere in the bryozoa after the expulsion of the larvae; the animal economizes its carapace in this way.

*Occurrence.*—Upper Jacksonian (Ocala limestone): Old factory, 1½ miles above Bainbridge, Georgia (very rare).

*Holotype.*—Cat. No. 63932, U.S.N.M.

### AMPHIBLESTRUM CURVATUM, new species.

Plate 81, fig. 4.

The zoarium incrusts other bryozoa. The zooecia are distinct, wide, pyriform; the cryptocyst is concave, finely granular, shorter than the opesium. The opesium is anterior, pyriform. The ovicell is globular, salient, hyperstomial, never closed by the operculum, ornamented with a large frontal, granular callosity. The avicularium is interzooecial and *curved;* the pivot is formed by two small lateral denticles.

*Measurements.*—Opesia $\left\{\begin{array}{l} ho=0.12\text{–}0.15 \text{ mm.} \\ lo=0.12 \text{ mm.} \end{array}\right.$ Zooecia $\left\{\begin{array}{l} Lz=0.30\text{–}0.35 \text{ mm.} \\ lz=0.25 \text{ mm.} \end{array}\right.$

*Affinities.*—The avicularium is analogous to that in the recent *Callopora curvirostris* Hincks, 1861. (See fig. 37.) We have copied figures after Waters to show the reader how this sort of avicularium must be restored. It must not be confounded with the onychocellarium having a membranous expansion. The paleontologist is always obliged to compare the fossil vestiges with similar organs of the recent species.

This species differs from *Callopora curvirostris* Hincks, 1881, in which the mural rim is very thin, by the presence of its large cryptocyst.

It differs from *Amphiblestrum flammeum* in its smaller dimensions and its curved avicularia.

*Occurrence.*—Vicksburgian ("Chimney rock" of Marianna limestone): One mile north of Monroeville, Alabama (rare).

*Holotype.*—Cat. No. 64235, U.S.N.M.

KEY TO SPECIES OF AMPHIBLESTRUM.

| | | |
|---|---|---|
| 1. | Opesium semilunar | A. *orbiculatum.* |
| | Opesium oval or elliptical | 2 |
| 2. | Avicularia curved | A. *curvatum.* |
| | Avicularia straight | 3 |
| 3. | Two pores at the base of the zooecium | A. *biporosum.* |
| | No pores at the base of the zooecium | 4 |
| 4. | Zooecia small elongated (*Lz*=0.35 mm.) small avicularia | A. *productum.* |
| | Zooecia large and wide (*Lz*=0.40–0.60 mm.) large avicularia | 5 |
| 5. | Mural rim complete, long, distal canal on the avicularium | A. *flammeum.* |
| | Mural rim incomplete, very short, distal canal on the avicularia | A. *patens.* |

### Genus RAMPHONOTUS Norman, 1894.

1894. *Ramphonotus* Norman, A Month on the Trondhjem Fjord, Annals and Magazine Natural History, ser. 6, vol. 13, p. 122.

The zooecia, if developed freely in form, are pyriform, widening upward from the base, with a calcareous portion posterior to and occupying a larger part of the front wall than that of the membranous portion; the membranous portion of the area is nearly as wide as long and often somewhat trifoliate in shape; the mouth opening is simple and, as usual, close to its anterior margin; the border surrounding the membranous area is calcareous. There may be lateral spines. Ovicells large, globose, and imperforate, hyperstomial, and never closed by the operculum. An acute bird's-beaklike avicularium mounted on a pedicel, with acute mandible of large size (often monstrously so), would seem to be habitually developed on the adult zooecium situated on the central portion of the zooecium on or immediately behind the hinder margin of the area. Dietellae: two pairs of lateral and one distal—the former very narrow and rarely extending beyond the side walls; the latter small and apparently sometimes not present. (Norman, 1903.)

*Genotype.*—*Ramphonotus minax* Busk, 1860.

*Range.*—Senonian-Recent.

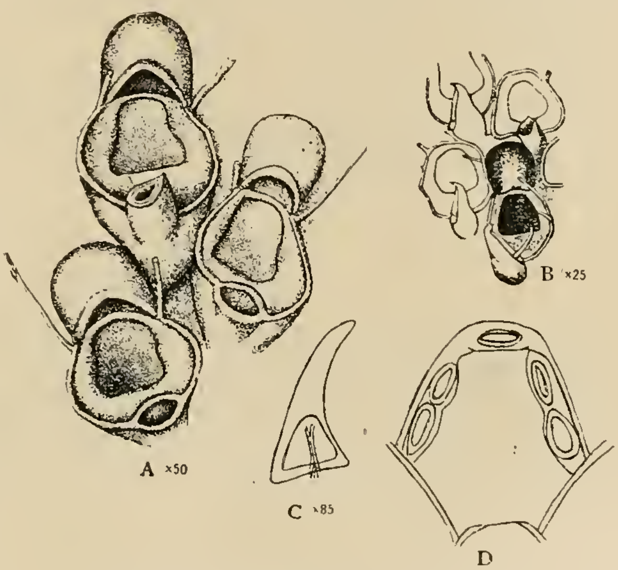

Fig. 39.—Genus *Ramphonotus* Norman, 1894.

A–D. *Ramphonotus minax* Busk, 1860. A. Ovicelled zooecia, × 50. B. Zooecia showing avicularium with mandible, × 25. (After Hincks, 1880.) C. Mandible, × 85. (After Nordgaard, 1905.) D. Dietellae. (After Norman, 1903.)

In this genus the cryptocyst is more reduced than in *Amphiblestrum* Gray, 1848; there are even species which are without this structure. The presence of the pedicellar avicularia near the proximal border of the opesium is in reality the only characteristic of the genus.

The species, in addition to the genotype, which may be classed in *Ramphonotus*, are:

*Ramphonotus bassleri* Canu, 1911, Rocanean.

*Ramphonotus* (*Amphiblestrum*) *cylindriformis* MacGillivray, 1895.

*Ramphonotus* (*Membranipora*) *elliptica* forma *monostachys* Hennig, 1892 Senonian.

*Ramphonotus* (*Membranipora*) *sigillata* Pourtales, 1870.

### RAMPHONOTUS LEVIS, new species.

Plate 1, fig. 14.

*Description.*—The zoarium incrusts shells. The zooecia are distinct, elongated, pyriform, with a convex gymnocyst: the mural rim is thin, salient, a little enlarged at the base. The opesium is oval, anterior, entire. The median avicularium is small and projects very little.

*Measurements.*—Opesia $\begin{cases} ho=0.36\text{ mm.} \\ lo=0.12\text{ mm.} \end{cases}$ Zooecia $\begin{cases} Lz=0.35\text{–}0.40\text{ mm.} \\ lz=0.24\text{ mm.} \end{cases}$

*Affinities.*—Calcified zooecia perforated by a large, round pore and ornamented with a distal crescent may be observed. There are also imperforated calcified zooecia.

This species differs from *Ramphonotus baccatus* in its smooth mural rim, and from *Ramphonotus regularis* in its small dimensions.

*Occurrence.*—Lowest Eocene (Bryozoan bed at base of Aquia formation): Upper Marlboro, Maryland (very rare).

*Holotype.*—Cat. No. 63776, U.S.N.M.

### RAMPHONOTUS SLOANI, new species.

Plate 4, fig. 4.

*Description.*—The zoarium incrusts shells. The zooecia are little distinct, joined laterally to one another; elongated, elliptical; the mural rim is wide, flat, very oblique, finely granulated. The opesium is elliptical, elongated, quite finely crenulated. The ovicell is hyperstomial, never closed by the opercular valve, globular, very salient; it is ornamented in front by a triangular cicatrix. The avicularium is large, transverse, elliptical, with pivot, salient.

*Measurements.*—Opesia $\begin{cases} ho=0.30\text{–}0.35\text{ mm.} \\ lo=0.20\text{ mm.} \end{cases}$ Zooecia $\begin{cases} Lz=0.50\text{ mm.} \\ lz=0.30\text{–}0.35\text{ mm.} \end{cases}$

*Variations.*—The ovicell takes the place of the large distal avicularia, according to the rule in the genus. The latter is replaced by two small avicularia with pivot placed in the interzooecial angles.

*Affinities.*—This is the largest species of *Ramphonotus* found in our American formations. The micrometric dimensions and the size of its avicularium differentiate it clearly from the other species.

We dedicate this fine new species to Mr. Earle Sloan, of Charleston, South Carolina, who has been of great assistance to us in securing specimens from various localities in his State.

The only specimen found has been figured.

*Occurrence.*—Midwayan (Clayton limestone): Brundidge, Alabama (very rare).

*Holotype.*—Cat. No. 63798, U.S.N.M.

### RAMPHONOTUS BACCATUS, new species.

Plate 30, fig. 5.

*Description.*—The zoarium incrusts shells. The zooecia are small, distinct, pyriform with a short gymnocyst: the mural rim is prominent, flat, oblique, granular. The opesium is elongate, oval. The ovicell is hyperstomial, never closed by the opercular valve. The small pedicellated avicularium is slightly projecting and rounded.

*Measurements.*—Opesia $\left\{\begin{array}{l} ho=0.18\text{ mm.}\\ lo=0.10\text{ mm.}\end{array}\right.$ Zooecia $\left\{\begin{array}{l} Lz=0.35\text{ mm.}\\ lz=0.20\text{ mm.}\end{array}\right.$

*Affinities.*—The figured specimen represents the area about the ancestrula, and the marginal zooecia are alone considered as normal. We have observed some zooecia with the mural rim double, which in consequence have undergone total regeneration.

This species differs from *Ramphonotus levis* in its granular mural rim which has somewhat the aspect of a collar of pearls.

*Occurrence.*—Middle Jacksonian (Castle Hayne limestone): Wilmington, North Carolina (very rare).

*Holotype.*—Cat. No. 63933, U.S.N.M.

### RAMPHONOTUS REGULARIS, new species.

Plate 30, figs. 6–8.

The zoarium incrusts shells. The zooecia are distinct, elongated, pyriform; the mural rim is thin, salient, *regular*. The opesium in anterior, oval, very finely crenulated. The ovicell is hyperstomial, never closed by the opercular valve: globose, projecting, with a large frontal callosity, granular. The median avicularium is very salient, transverse, and its orifice is perpendicular to the zooecial plane. The ancestrula is a very small zooecium of the ordinary kind.

*Measurements.*—Opesia $\left\{\begin{array}{l} ho=0.28\text{ mm.}\\ lo=0.18\text{–}0.22\text{ mm.}\end{array}\right.$ Zooecia $\left\{\begin{array}{l} Lz=0.40\text{–}0.42\text{ mm.}\\ lz=0.30\text{ mm.}\end{array}\right.$

*Variations.*—The second calcareous layer of the ovicell is very small and forms only a thin smooth border around it. Regenerated zooecia appear to be rare. Some calcified zooecia perforated with a round pore have been noted. Figure 8 shows a zooecium with a monstrous avicularium.

This species differs from both *Ramphonotus levis* and *R. baccatus* in its large dimensions and in the regularity of its mural rim.

*Occurrence.*—Middle Jacksonian (Castle Hayne limestone): Wilmington, North Carolina (common).

*Cotypes.*—Cat. No. 63934, U.S.N.M.

### Genus TEGELLA Levinsen, 1909.

1909. *Tegella* LEVINSEN, Morphological and Systematic Studies on the Cheilostomatous Bryozoa, p. 152.

The zooecia, which have spines and a slightly developed cryptocyst, are provided with multiporous rosette plates (septulae). Hyperstomial ovicell with an incompletely calcified ectooecium, which is again surrounded by avicularia. (Levinsen.)

*Genotype.*—*Tegella* (*Membranipora*) *unicornis* Fleming, 1828.

*Range.*—Santonian-Recent.

The recent species of the genus are:

*Tegella* (*Membranipora*) *unicornis* Fleming, 1828.
*Tegella* (*Membranipora*) *sophiae* Busk, 1885.
*Tegella* (*Membranipora*) *occultata* Robertson, 1908.

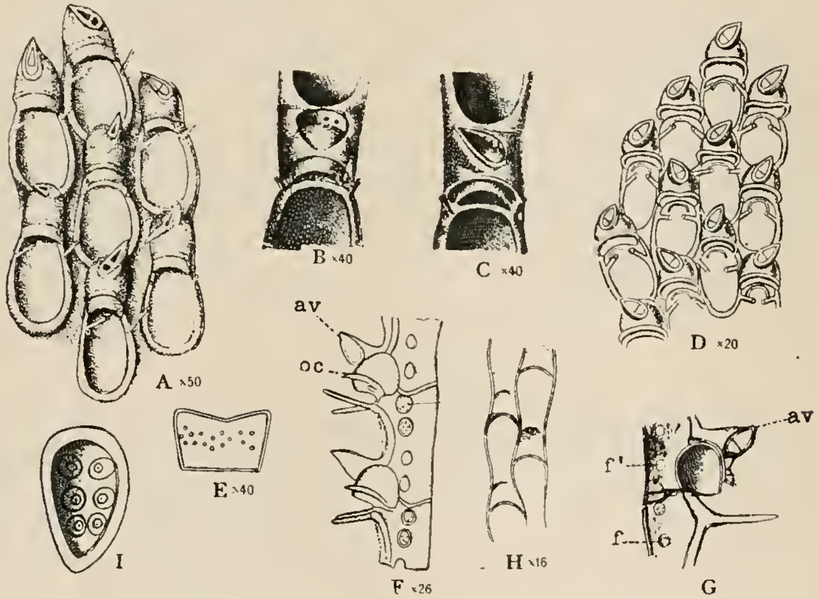

Fig. 40.—Genus *Tegella* Levinsen, 1909.

A–I. *Tegella unicornis* Fleming, 1828. A. Ovicelled zooecia, × 50. (After Hincks, 1880.) B. C. Two views, × 40, showing development of the avicularium. (After Levinsen, 1909.) D. Zooecia, × 20. E. Distal wall with uniporous septulae, × 40. F. Lateral wall, showing multiporous septulae, × 26; *av*, avicularium; *oc*, ooecium. G. Section through the ovicell, × 33; *av*, avicularium; *f*, *f'*, septulae. H. Inferior face, × 16. I. A multiporous septula, greatly magnified. (D–I after Levinsen, 1894.)

The fossil species are:

*Tegella* (*Membranipora*) *griffithi* Brydone, 1906.
*Tegella* (*Membranipora*) *trimminghamensis* Brydone, 1910.

In reality in the fossil species the avicularium does not surround the ovicell, but surmounts it and is intimately attached to it.

### TEGELLA ACULEATA, new species.

Plate 30, fig. 11.

The zoarium incrusts small shells. The zooecia are large, distinct, elongated, pyriform, with a long convex gymnocyst; the mural rim is salient, very thin, regular, with 4 to 8 distal hollow spines. The opesium is anterior, oval, or elliptical, entire. The ovicell is hyperstomial, never closed by the opercular valve, globose, smooth, ornamented with a small frontal linear callosity. The median avicularium is salient and transverse. The interopesial avicularia are long, very thin, and *pointed*.

*Measurements.*—Opesia $\left\{\begin{array}{l} ho=0.27\text{–}0.30 \text{ mm.} \\ lo=0.23\text{–}0.30 \text{ mm.}\end{array}\right.$ Zooecia $\left\{\begin{array}{l} Lz=0.72 \text{ mm.} \\ lz=0.35 \text{ mm.}\end{array}\right.$

*Variations.*—The interzooecial avicularium is always placed exactly in the axis of the proximal zooecium with which it appears in immediate relation. On the figured specimen an avicularium may be seen developed on the distal zooecia. There are only two pairs of symmetrical spines on the ovicelled zooecia. The ovicell is formed of two calcareous lamellae. The external lamella (ectooecium of Levinsen) covers the lower lamella almost entirely and leaves only a thin linear portion of it visible. The presence of large avicularia gives the zoarium the aspect of being *armed with small swords.*

Whenever an interopesial avicularium does not surmount the ovicell, it is much smaller.

*Affinities.*—The close connection of the ovicell with the distal avicularium renders it necessary to class this species in *Tegella* Levinsen, 1909, and its pedicellated avicularium would place it in *Ramphonotus* Norman, 1894. Such contradictions are inevitable when characters of adaptation like the avicularium are employed in classification. It is easy to avoid this by giving the genera broader limits precisely as Levinsen has done with the genus *Callopora.*

*Occurrence.*—Middle Jacksonian (Castle Hayne limestone): Wilmington, North Carolina (rare).

*Holtoype.*—Cat. No. 63936, U.S.N.M.

### TEGELLA NICKLESI, new species.

Plate 30, figs. 9, 10.

The zoarium incrusts pebbles. The zooecia are elongated, distinct, elliptical or oval, and provided with a very small gymnocyst; the mural rim is thin, salient, convex, ornamented with spines. The opesium is regular and similar in form to the zooecia. The ovicell is hyperstomial, never closed by the opercular valve, small, convex. It is surmounted by an elliptical, elongated avicularium placed exactly in the axis itself of the proximal zooecium.

*Measurements.*—Opesia $\begin{array}{l} ho=0.30 \text{ mm.} \\ lo=0.15\text{–}0.20 \text{ mm.}\end{array}$ Zooecia $\left\{\begin{array}{l} Lz=0.50 \text{ mm.} \\ lz=0.30 \text{ mm.}\end{array}\right.$

*Affinities.*—In the vicinity of the ancestrula the zooecia are smaller and lack the distal avicularium; here also their mural rim bears larger spines.

The species differs from *Tegella aculeata* in its small dimensions and in the absence of the median opesial avicularium.

It may be distinguished from *Tegella* (*Membranipora*) *triminghamensis* Brydone, 1910, by its smaller opesium and its much smaller spines.

The specific name is in honor of Mr. John M. Nickles, of the United States Geological Survey, whose work upon American Paleozoic bryozoa is well known.

*Occurrence.*—Middle Jacksonian: Eutaw Springs, South Carolina (very rare).

*Cotypes.*—Cat. No. 63935, U.S.N.M.

### Genus STAMENOCELLA Canu and Bassler, 1917.

1917. *Stamenocella* CANU and BASSLER, Synopsis of American Early Tertiary Cheilostome Bryozoa, Bulletin 96, United States National Museum, p. 21.

Ovicell hyperstomial not closed by the opercular valve. No dietellae. Gymnocyst long and flat, supporting a small sessile, salient avicularium.

*Genotype.*—*Stamenocella mediaviculifera* Canu and Bassler, 1917.

*Range.*—Senonian-Vicksburgian.

The genus which is nearest to this type of structure is *Bactrellaria* Marsson, 1887, in which the zooecia are identical, but are disposed on a single side of a triserial zoarium. The two genera undoubtedly belong to the same family.

The genus *Bugularia* Levinsen, 1909, the type of which is the recent *Carbasea dissimilis* Busk, 1896, appears very similar. Nevertheless its zooecia are disposed on only one side of the zoarium, the basal edge of its distal wall is angular and the ovicell is free. Levinsen has classed his genus *Bugularia* in the *Bicellariidae*, but his family is not an entirely natural one, as it contains three genera, *Bugula*, *Eucratea*, and *Bicellaria*, which have absolutely distinct larvae. It also contains *Chaperia*, in which the anatomical characters are quite different from *Bugula*.

In *Stamenocella* the gymnocyst supports the ovicell which is extremely fragile, and also the avicularium. The ovicell of the proximal zooecia forces the avicularium of the distal zooecia near to their opesia.

There may be classed in this genus—

*Stamenocella* (*Biflustra*) *fenestrella* D'Orbigny, 1852.

*Stamenocella* (*Flustrella*) *convexa* D'Orbigny, 1852.

*Stamenocella* (*Eschara*) *cuvieri* Von Hagenow, 1851.

The genus also probably includes the Cretaceous group of *Rhynchotella* Canu, which, however, presents some divergent characters. The name *Rhynchotella* can not be admitted in nomenclature because it was proposed by Canu as a simple artificial grouping to facilitate the determination of species.

#### STAMENOCELLA CYLINDRICA, new species.

Plate 1, fig. 15.

*Description.*—The zoarium is free, *cylindrical*, formed of 6 longitudinal rows of zooecia. The zooecia are long, distinct, a little narrowed behind: the mural rim is salient, wide, convex, smooth; the gymnocyst is flat, as long as half of the zooecium and bears 2 to 4 proximal punctations. The opesium is elliptical or oval.

*Measurements.*—Opesia $\begin{cases} ho=0.22\text{–}0.25 \text{ mm.} \\ lo=0.10 \text{ mm.} \end{cases}$ Zooecia $\begin{cases} Lz=0.70\text{–}0.72 \text{ mm.} \\ lz=0.25 \text{ mm.} \end{cases}$

*Affinities.*—Only the figured specimen has been found, which permits no serious study. It contains a calcified zooecium. It is possible, indeed, that the zoarium was articulated. The zooecia presents proximal punctations on the gymnocyst as do certain specimens of *Stamenocella mediaviculifera.* The present species differs, however, in its cylindrical zoarium and in its opesium which is twice as small.

*Occurrence.*—Lowest Eocene (Bryozoan bed at base of Aquia formation): Upper Marlboro, Maryland (very rare).

*Holotype.*—Cat. No. 63777, U.S.N.M.

### STAMENOCELLA MIDWAYANICA, new species.

Plate 4, figs. 5–9.

*Description.*—The zoarium is free, claviform, articulated (?), compressed, bilamellar, bearing on each face one to six longitudinal rows of zooecia. The zooecia are much elongated, distinct, contracted at the back, separated by a groove of little depth; the mural rim is flat, finely striated, enlarged at the base. The opesium is elliptical or somewhat oval. The radicular zooecia are perforated by a large round pore, and occur only at the base of the branches. The avicularium which is placed in the middle of the gymnocyst is cylindrical and very prominent; its orifice is oblique and turned toward the summit of the zoarium.

*Measurements.*—Opesia $\left\{\begin{array}{l} ho=0.24\text{–}0.30 \text{ mm.} \\ lo=0.10\text{–}0.12 \text{ mm.} \end{array}\right.$ Zooecia $\left\{\begin{array}{l} Lz=0.50 \text{ mm.} \\ lz=0.20 \text{ mm.} \end{array}\right.$

*Affinities.*—The club-shaped fragments of this species were not necessarily articulated, but unquestionably the zoarium was provided with rootlets and its fronds in growing away from the ancestrula became broader and broader.

This species belongs to a group frequent in the Upper Cretaceous, which Canu has classed in the artificial and unfortunately named division, *Rhynchotella,* which is distinguished from *Stamenocella* only by the absence of known ovicells. As the latter are very rare in our genus, and as the number of specimens is insufficient, it is necessary to hesitate before founding another generic type.

Our species differs from *Membranipora* (*Flustrella*) *echinata* D'Orbigny, 1852,[1] in its much smaller micrometric dimensions ($Lz=0.50$ mm. instead of 0.80 mm.). The other species of the same group cited by D'Orbigny are very vigorous, robust, and their zoarium is at least five times larger, so comparison is not necessary.

*Occurrence.*—Midwayan (Clayton limestone): Mabelvale, near Little Rock, Arkansas (common); 1 mile west of Fort Gaines, Georgia (very rare); Luverne, Crenshaw County, Alabama (very rare).

*Cotypes.*—Cat. No. 63799, U.S.N.M.

### STAMENOCELLA ANATINA, new species.

Plate 30, fig. 12.

*Description.*—The zoarium is free and bilamellar: it is formed of large, flat fronds; the two lamellae are inseparable and back to back. The zooecia are very large, elongated, distinct, separated by a furrow; the mural rim is little salient, flat, oblique, thin distally, much enlarged and transformed into a cryptocyst proximally; the gymnocyst is little convex and smooth. The opesium is anterior, elliptical, entire. The avicularium occupies the surface of the gymnocyst; it is large, salient, and terminated like the beak of a *duck*, with spatulate mandible.

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[1] Paleontologie Francaise, Terrain Cretace, Bryozoaires, vol. 5, pl. 699, fig. 11.

*Measurements.*—Opesia $\left\{\begin{array}{l} ho=0.35\text{–}0.40\text{ mm.}\\ lo=0.17\text{ mm.}\end{array}\right.$ Zooecia $\left\{\begin{array}{l} Lz=0.85\text{–}1.00\text{ mm.}\\ lz=0.35\text{ mm.}\end{array}\right.$

*Affinities.*—The figured specimen is the only one that has been found and it unfortunately has no ovicell. The large avicularium is not constant, although many of the zooecia are unprovided with them; their presence is therefore not necessary to each zooecium. We think that the function of the avicularia, like that of the vibracula, is rather zoarial.

Among the species of the same genus this is the only one in which the cryptocyst is much developed; its relationships with the genus *Amphiblestrum* are therefore close; but in the latter there is no gymnocyst and the avicularia are lodged in the interzooecial angles.

The disposition of the zooecia is also much less regular than in the other species of *Stamenocella.* It differs from *Stamenocella grandipora* in its small opesial length (0.35 instead of 0.50), its cryptocyst, and chiefly in its large avicularium in the shape of a duck's beak.

*Occurrence.*—Lower Jacksonian (Moodys marl): Jackson, Mississippi (very rare).

*Holotype.*—Cat. No. 63937, U.S.N.M.

### STAMENOCELLA PYRIFORME, new species.

Plate 30, figs. 13–16.

*Description.*—The zoarium is bilamellar with narrow fronds; the two lamellae are back to back and separable. The zooecia are very long, narrow, distinct, separated by a salient thread. The opesium is narrow, *pyriform*, the point toward the bottom, bordered by a collar. The cryptocyst is smooth, developed laterally and inferiorly to the opesium. The ovicell is globular, salient, embedded in the cryptocyst of the distal zooecium; its orifice can not be closed by the operculum. The avicularium is small, salient, elliptical, provided with a pivot or two lateral denticles.

*Measurements.*—Opesia $\left\{\begin{array}{l} ho=0.32\text{–}0.35\text{ mm.}\\ lo=0.10\text{–}0.15\text{ mm.}\end{array}\right.$ Zooecia $\left\{\begin{array}{l} Lz=0.55\text{–}0.60\text{ mm.}\\ lz=0.15\text{–}0.20\text{ mm.}\end{array}\right.$

*Variations.*—The lateral zooecia have an elliptical and nonpyriform opesium (figs. 13, 14). On the very wide fronds there are many rows of these different zooecia. The avicularia of the lateral zooecia are much more prominent and appear claw-shaped (figs. 13, 14).

When it is properly illuminated, the peculiar orifice of the ovicell is quite visible. It is large, placed above the opesium, and the opercular valve can never close it.

*Affinities.*—In its small micrometric dimensions this species clearly differs from the others. It is rather close to *Stamenocella inferaviculifera*, whose opesium is often pyriform; it is distinguished from it by the very peculiar disposition of its cryptocyst, which is developed laterally and inferiorly to the opesium.

*Occurrence.*—Lower Jacksonian (Moodys marl): Jackson, Mississippi (common).

*Cotypes.*—Cat. No. 63938, U.S.N.M.

### STAMENOCELLA MEDIAVICULIFERA Canu and Bassler, 1917.

Plate 31, figs. 1–5.

1917. *Stamenocella mediaviculifera* CANU and BASSLER, Synopsis of American Early Tertiary Cheilostome Bryozoa. Bulletin 96, United States National Museum, p. 22, pl. 3, fig. 1.

*Description.*—The zoarium is bilamellar, with the two lamellae back to back and inseparable. The zooecia are very elongated, narrowed behind, distinct or indistinct; the mural rim is thin, salient, somewhat enlarged and attenuated, rounded, smooth. The opesium is elliptical or oval, entire; the gymnocyst is flat or somewhat convex and nearly as long as the opesium. The avicularium is salient and placed in the *middle* of the gymnocyst. The ovicell is rarely intact.

*Measurements.*—Opesia $\begin{cases} ho=0.40 \text{ mm.} \\ lo=0.16 \text{ mm.} \end{cases}$ Zooecia $\begin{cases} Lz=0.80 \text{ mm.} \\ lz=0.20\text{-}0.24 \text{ mm.} \end{cases}$

*Variations and affinities.*—This species apparently lived in agitated waters. Although widely distributed, it is often very rare, and specimens are always more or less worn. In this condition the mural rim is worn away and invisible, the zooecia indistinct, and the avicularia absent or replaced by a concave cicatrix (fig. 2). We have never found the ovicell intact; it is always more or less broken, but its place is clearly visible on the gymnocyst, notably in the specimens from near Perry, Georgia (fig. 3). The avicularium is of the simple type without denticles or pivot. The dimensions in this species are much smaller than in *S. grandis*, and it is rarely as well preserved. On certain specimens from Rich Hill, Georgia, we have observed sometimes four punctations at the base of the gymnocyst. The rare specimens from the Vicksburgian are very mediocre in preservation and have the abraded aspect shown in figure 5.

*Occurrence.*—Middle Jacksonian: Rich Hill, Crawford County, Georgia (very common); 3¼ miles south of Perry, Georgia (very common); 18 miles west of Wrightsville, Johnson County, Georgia (rare); 3½ miles north of Grovania, Georgia (rare); 12 miles southeast of Marshallville, Georgia (rare); 17 miles northeast of Hawkinsville, Georgia (rare); one-half mile southeast of Georgia Kaolin Company Mine, Twiggs County, Georgia (rare); Baldock, Barnwell County, South Carolina (rare); Wilmington, North Carolina (rare).

Vicksburgian (Marianna limestone): Salt Mountain, 5 miles south of Jackson, Mississippi (doubtful); near Claiborne, Monroe County, Alabama (doubtful).

*Cotypes.*—Cat. Nos. 62581, 63939, 63940, U.S.N.M.

### STAMENOCELLA INFERAVICULIFERA, new species.

Plate 31, figs. 6–15.

The zoarium is free with the two lamellae inseparable and growing back to back. The zooecia are elongated, distinct, narrowed in back: the mural rim is little salient, very thin, attenuate at its base. The opesium is elliptical or oval, entire; the gymnocyst is flat, smooth. The marginal zooecia have no avicularia. The ovicell is small, globular, fragile, placed on the gymnocyst of the distal zooecia, closed by the operculum. The avicularium is situated on the *inferior* portion of the gymnocyst in close contact with the mural rims of the proximal zooecium.

*Measurements.*—Opesia $\begin{cases} ho=0.30\text{–}0.36 \text{ mm.} \\ lo=0.10\text{–}0.16 \text{ mm.} \end{cases}$ Zooecia $\begin{cases} Lz=0.70\text{–}0.74 \text{ mm.} \\ lz=0.24\text{–}030 \text{ mm.} \end{cases}$

*Variations.*—This species is exceedingly variable and its study has required considerable effort; moreover it appears at several distinct horizons in the Jacksonian and Vickburgian. The more perfect specimens shown in our figures are extremely rare: the avicularium here assumes a peculiar form without axis or pivot, which makes its nature doubtful.

Figure 10 shows that on the same zoarium there may be extraordinary variations. Here the broken ovicell appears to be quite voluminous and to crowd the avicularium close to the opesium. In specimens from Monroeville, Alabama, the proximal avicularium is smaller (fig. 14). In the course of weathering they become smaller and smaller (fig. 11), divide in two, and even may be replaced by a few punctations (fig. 13).

The opesium is sometimes elliptical and sometimes oval. The two forms occur on the same specimen (fig. 7).

The ovicell is quite variable in form and even in the same locality it is impossible to find it of a constant size and shape.

*Affinities.*—On certain rather well preserved specimens the avicularium is identical with that of *Stamenocella mediaviculifera* (figs. 7, 8), that is to say, it is of simple form with neither axis nor pivot. In only a single instance (fig. 12) have we observed a pivot which left no doubt as to the reality of this organ.

Like the preceding species, *S. inferaviculifera* is found principally in the Jacksonian although it is also common in the Vicksburgian.

*Occurrence.*—Middle Jacksonian (Castle Hayne limestone): Wilmington, North Carolina (very rare).

Upper Jacksonian (Ocala limestone): 9 miles north of Ocala, Florida (rare); Alachua, Florida (common).

Vicksburgian (Marianna limestone): 1 mile north of Monroeville, Alabama (common); Salt Mountain, 5 miles south of Jackson, Alabama (rare); west bank of Conecuh River, 1 mile below mouth of Sepulga River, Escambia County, Alabama (rare); Murder Creek, east of Castlebury, Conecuh County, Alabama (rare).

Vicksburgian (Red Bluff clay): One-fourth mile west of Woodward, Wayne County, Mississippi (rare).

*Cotypes.*—Cat. No. 63941–63945, U.S.N.M.

### STAMENOCELLA GRANDIS, new species.

Plate 31. fig. 16.

*Description.*—The zoarium is bilamellar and free. The zooecia are *large*, distinct, very elongate, narrow, especially at the back; the mural rim is thin, salient, curved, thinnest at the base. The opesium is large, entire, elliptical. The avicularium is small, salient, obliquely directed toward the top of the zoarium.

*Measurements.*—Opesia $\left\{\begin{array}{l} ho=0.60\text{–}0.70 \text{ mm.} \\ lo=0.20\text{–}0.22 \text{ mm.} \end{array}\right.$ Zooecia $\left\{\begin{array}{l} Lz=1.10\text{–}1.20 \text{ mm.} \\ lz=0.32\text{–}0.35 \text{ mm.} \end{array}\right.$

*Variation and affinities.*—The micrometric measures are quite variable, but are always larger than those of closely allied species. We have specimens from near Monroeville, Alabama, and near Woodward, Mississippi, where the zooecial length is 1 mm. At the Chipola River locality they vary between 0.84 mm. and 0.90 mm.

The surface ornamentation is much less variable than in *S. mediaviculifera* which probably inhabited areas with more rapid marine currents. The form of the zooecium is that of a stamen with a large anther whence the generic name.

*Occurrence.*—Vicksburgian ("Chimney rock" of Marianna limestone): One mile north of Monroeville, Alabama (rare).

Vicksburgian (Byram marl): One-fourth mile west of Woodward, Wayne County, Mississippi (rare).

Upper Jacksonian (Ocala limestone): Chipola River, east of Marianna, Jackson County, Florida (very rare).

*Holotype.*—Cat. No. 63946, U.S.N.M.

### STAMENOCELLA INTERMEDIA, new species.

Plate 81, fig. 5.

*Description.*—The zoarium is free, compressed, formed of two lamellae growing back to back and inseparable. The zooecia are distinct, elongated, with a concave gymnocyst; the mural rim is thin, salient, curved, finely granulated. The opesium is elliptical or oval, the narrow part at the base. The hyperstomial ovicell appears voluminous. The avicularium is placed in the middle of the gymnocyst; it is large and salient; its orifice is oblique and turned toward the lower part of the zoarium.

*Affinities.*—We have found only the single fragment figured which has appeared very interesting to us on account of its general aspect which approaches that of a *Bugula* with a bilamellate zoarium.

*Stamenocella intermedia* differs from *S. mediaviculifera* in its smaller micrometric dimensions and its four longitudinal rows of zooecia.

It is readily distinguished from *Stamenocella midwayanica* by its avicularium directed toward the base of the zoarium.

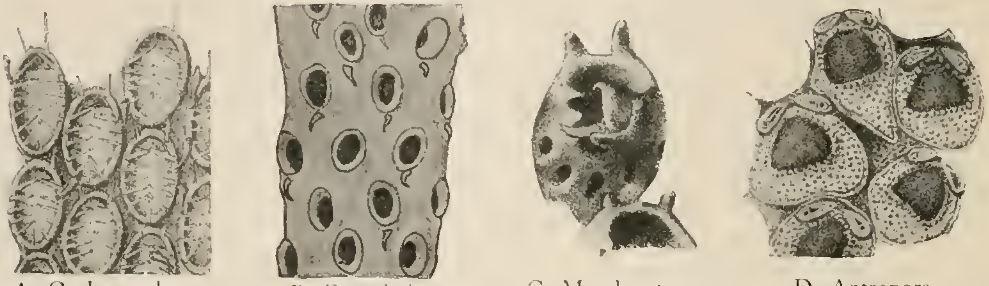
This species is really intermediate between typical *Stamenocella* and the aforementioned group of *Membranipora* (*Flustrella*) *polymorpha* D'Orbigny, 1852.

*Occurrence.*—Vicksburgian (Glendon member of Márianna limestone): West bank of Conecuh River, 1 mile below mouth of Sepulga River, Escambia County, Alabama (very rare).

*Holotype.*—Cat. No. 64236, U.S.N.M.

## GENERA OF MEMBRANIPORAE UNREPRESENTED.

For the sake of completeness, definitions and illustrations of the remaining genera of this group are introduced below, even though fossil representatives of them have not yet been found in the American Tertiary.



A. Cauloramphus B Foveolaria C. Membrostega D. Antropora

Fig. 41.—Miscellaneous genera of Membraniporae.

A. *Cauloramphus spinifer* Norman, 1903. × 25. Recent.
B. *Foveolaria elliptica* Busk, 1884, × 25. Recent.
C. *Membrostega ferox* Kirkpatrick, 1890, × 30. Recent.
D. *Antropora granulifera* Hincks, 1880. × 30. Recent.

### Genus CAULORAMPHUS Norman, 1903.

1903. *Cauloramphus* Norman, Natural History of East Finmark, Annals and Magazine Natural History, ser. 7, vol. 11, p. 587.

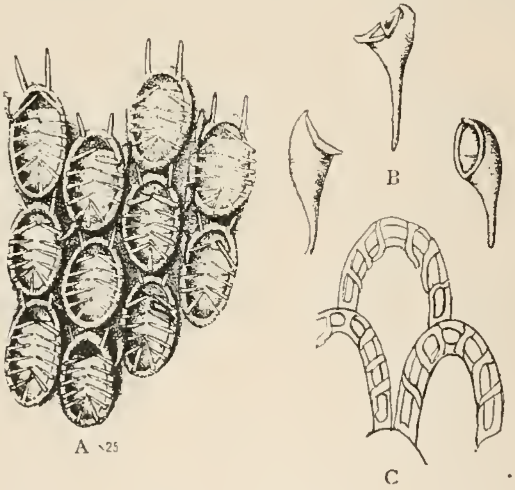


Fig. 42.—Genus *Cauloramphus* Norman, 1903.

A–C. *Cauloramphus spinifer* Johnston, 1832. A. Zooecia, × 25, showing the stout spines. B. Three views of the pedunculate avicularia. (A, B after Hincks, 1880.) C. Sketch showing dietellae. (After Norman, 1903.)

Front wall entirely membranous, the calcareous border bearing spines. Avicularia stalked and situated among the spines on the lateral margin of the zooecium; ovicell, when present, very shallow and inconspicuous. Dietellae in the type, three pairs of lateral and one terminal; the latter is sometimes divided into two or even three small chambers.

*Genotype.—Cauloramphus* (*Flustra*) *spinifer* Johnston. Recent.

This is the *Membranipora echinus* group of Waters, which he defines as follows: "Ovicells unknown; avicularia pediculate or articulate." However, the genotype itself is classed in the *Membranipora lineata* group with "ovicell with rib."

### Genus AMMATOPHORA Norman, 1903.

1903. *Ammatophora* Norman, Natural History of East Finmark. Annals and Magazine Natural History, ser. 7, vol. 12, p. 88.

Zooecia and ovicell depressed and flattened. Zooecia subovate: a calcareous crest occupying about two-thirds of the area. Oral opening distal end of the membranous portion. Walls thin, terminating at the ovicell in a knob. Ovicell entirely separable from the zooecium, resting on the knobs just mentioned; of unusual and varied form. Surface of zoarium with raised nodulous processes. No avicularia. No dietellae. (Norman.)

*Genotype.—Ammatophora* (*Membranipora*) *nodulosa* Hincks, 1880. Recent.

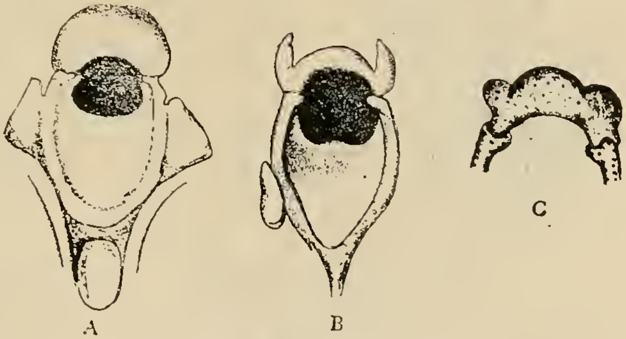


Fig. 43.—Genus *Ammatophora* Norman, 1903.

A–C. *Ammatophora nodulosa* Hincks, 1880. A. A zooecium exhibiting an unusual form of the ovicell. B. The younger condition of the more usual form. C. The mature condition of the same. (A–C after Norman, 1903.)

The opercular valve never closes the ovicell.

### Genus MARSSONOPORA Lang, 1914.

1914. *Marssonopora* Lang, Cretaceous Cheilostome Polyzoa, Geological Magazine, ser. 6, vol. 1, p. 438.

The zoarium is uniserial and incrusting. The zooecia are pyriform; the gymnocyst is quite convex. It bears on its caudal portion a small avicularium. The opesium is surrounded by large spines. The ovicell is hyperstomial, small, globular, and salient; it is closed by a special operculum. (See fig. 35, p. 141.)

*Genotype.—Marssonopora dispersa* Hagenow, 1839. Upper Senonian.

### Genus ANTROPORA Norman, 1903.

1903. *Antropora* Norman, Natural History of East Finmark, Annals and Magazine Natural History, ser. 7, vol. 12, p. 87.

The cryptocyst is largely displayed all around the opesium. A pair of avicularia with their pointed mandible directed inward, and transversely situated above the oral opening. There are three pairs of lateral dietellae and several (four usually) lucid spots in the hind wall. (After Norman.)

*Genotype.*—*Antropora* (*Membranipora*) *granulifera* Hincks, 1880. Recent.

### Genus MEMBROSTEGA Jullien, 1903.

1903. *Membrostega* Jullien, Bryozoaires provenant des campagnes de *l'Hirondelle*, p. 62.

The mural rim is provided with four spines on the anterior lips of the orifice. The two outer spines acquire such development that they form by their ramifications and their confluence an adventitious frontal above the real frontal, seeming to transform the Membraniporidae into veritable Costulidae.

*Genotype.*—*Membrostega* (*Lepralia*) *ferox* MacGillivray, 1868. Recent.

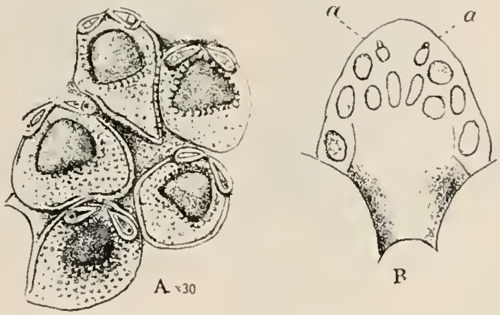


Fig. 44.—Genus *Antropora* Norman, 1903.

A, B. *Antropora granulifera* Hincks, 1880. A. Several zooecia, × 30. (After Hincks, 1880.) B. View of the back of a zooecium. *a*, openings resulting from the avicularia; below these are seen the pair of lucid bays, and below again the lucid spots. (After Norman, 1903.)

### Genus MEGAPORA Hincks, 1877.

1877. *Megapora* Hincks, On British Polyzoa, Annals and Magazine Natural History, ser. 4, vol. 20, p. 529.

The zooecia have a strongly developed, partially depressed cryptocyst, and an aperture surrounded by spines and with a well-developed vestibular arch. A compound operculum in which the valvular part and the accessory part are connected by a joint. A few pored dietellae. No avicularia. Hyperstomial ovicell, not closed by the opercular valve.

*Genotype.*—*Megapora ringens* Hincks, 1877. Recent.

### Genus DISCOFLUSTRELLARIA D'Orbigny, 1851.

1851. *Discoflustrellaria* D'Orbigny, Paleontologie française, Terrain Cretace, vol. 5, Byrozoaires, p. 507.

The zoarium is free, orbicular, convex, often conical above, always concave below, composed of zooecia regularly arranged in radiating lines, each beginning with a deformed zooecium with the formation of annular transverse lines. Zooecia round or square, entirely open and deep. The side opposite the zooecial openings presents regular radiating lines not perforated at their surface. (See fig. 24 I, p. 85).

*Genotype.*—*Discoflustrellaria doma* D'Orbigny, 1851. Cretaceous.

### Genus CREPIS Jullien, 1882.

1882. *Crepis* Jullien, Dragages du *Travailleur*, Bryozoaires draguees dans l'ocean Atlantique, Bulletin Societe Zoologique France, vol. 7, p. 522.

Oval zooecia, with cryptocyst, not completely closing the area in front, where a large opening existed during all of its life. This semielliptical opesium has its angles more or less rounded; the chitinous ectocyst, brilliant when it is dry, is calcified on its lateral walls, which are raised in front of the opesium and are prolonged at the back of the zooecium in a long thread, the end of which is united with the parietal ectocyst of the preceding zooecium. (See fig. 24 H, p. 85.)

*Genotype.—Crepis longipes* Jullien, 1882. Recent.

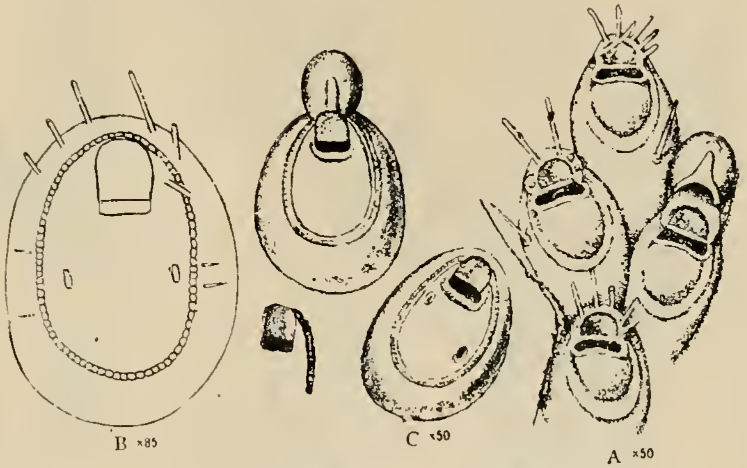


Fig. 45.—Genus *Megapora* Hincks, 1877.

A. *Megapora ringens* Hincks, 1880. Zooecia, × 50. (After Hincks, 1880.)

B, C. *Megapora hyalina* Waters, 1904. B. Sketch. × 85. showing the oral spines and the small lateral spines. C. Several zooecia, × 50. (B, C after Waters, 1904.)

### Genus FOVEOLARIA Busk, 1884.

1884. *Foveolaria* Busk, Voyage *Challenger,* Zoology, pt. 1, Cheilostomata, vol. 10, pt. 30, p. 68.

Zoarium erect, branched and cylindrical, or foliaceous and bilaminar. Front of zooecia with a thick granular border very deeply embedded in a pit formed by the thickening of the general ectocyst. A sessile avicularium immediately below or in front of the lower border of the pit.

*Genotype.—Foveolaria elliptica* Busk, 1884. Recent.

## Family AETEIDAE Smitt, 1867.

*Bibliography* (*Anatomical*).—Smitt, 1865, Om Hafs-Bryozoernas utveckling och fettkroppar, Öfversigt Kongl. Vetenskaps-Akademiens Förhandlingar, vol. 22, p. 11, pl. 2, figs. 5-14.—Waters, 1896, Notes on the Bryozoa from Rapallo and other Mediterranean localities, chiefly

Cellulariidae, Journal Linnean Society, London, Zoology, vol. 26, p. 5, pl. 1.—LEVINSEN, 1909. Morphologic and Systematic Studies on the Cheilostomatous Bryozoa, p. 92.—WATERS, 1913, Marine Fauna of British East Africa and Zanzibar, Bryozoa, Cheilostomata, Proceedings Zoological Society, London, 1913, p. 464, pl. 64, figs. 1, 2.

Zoarium composed of creeping branches more or less adherent to the substratum, often growing in free tufts adherent only part of their length. Zooecia uniserial, arising from each other in a tubular prolongation of greater or less length. Opesium terminal, opercular valve at its summit. (After Robertson.)

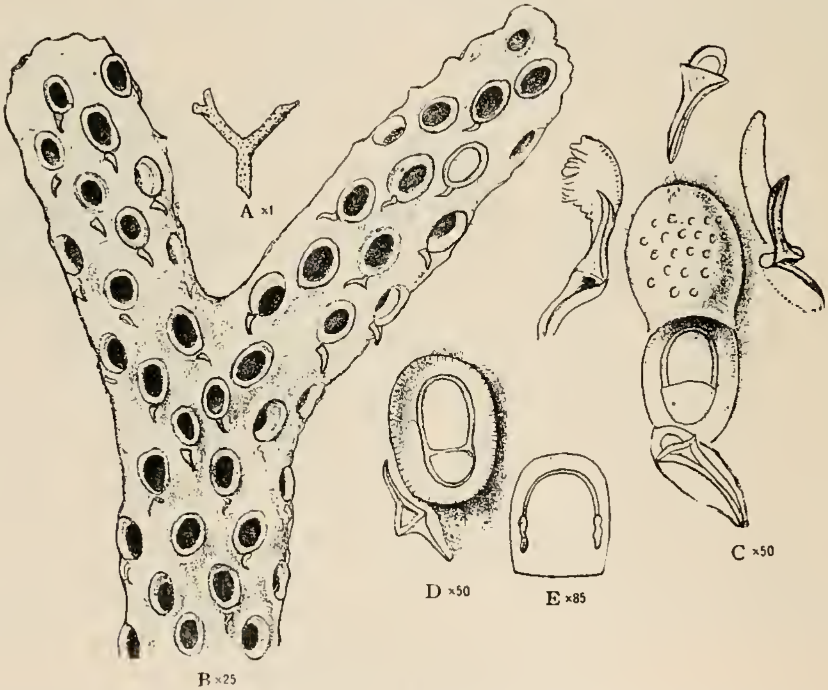


FIG. 46.—Genus *Foveolaria* Busk, 1884.

A–E. *Foveolaria elliptica* Busk, 1884. A. Zoarium, natural size. B. Portion of same, × 25. C. Avicularia and ovicell, × 50. D. Zooecium and avicularium, × 50. (A–D after Busk, 1884.) E. Operculum, × 85. (After Waters, 1889.)

### Genus AETEA Lamouroux, 1812.

1812. *Aetea* LAMOUROUX, Sur la Classification des Polypiers Coralligenes, Bulletin Sciences Sociéte Philomatique.

Zoarium adherent to the substratum. Each zooecium partially adherent, partially erect, the erect portion carrying at its distal extremity the membranous aperture with its operculum. (After Robertson.) Twelve tentacles.

*Genotype.*—*Aetea anguina* Linneaus, 1758.

*Range.*—Eocene-Recent.

### AETEA ANGUINA ? Linnaeus, 1758.

Plate 32, figs. 2, 3.

1758. *Sertularia anguina* Linnaeus, Systema Naturae, ed. 10, p. 816.

1889. *Aetea anguina* Jelly, Synonymic Catalogue Marine Bryozoa, p. 3 (cites general bibliography).

1913. *Aetea anguina* Canu, Memoires de l'Institut Egyptien, vol. 6, p. 190 (cites paleontologic bibliography).

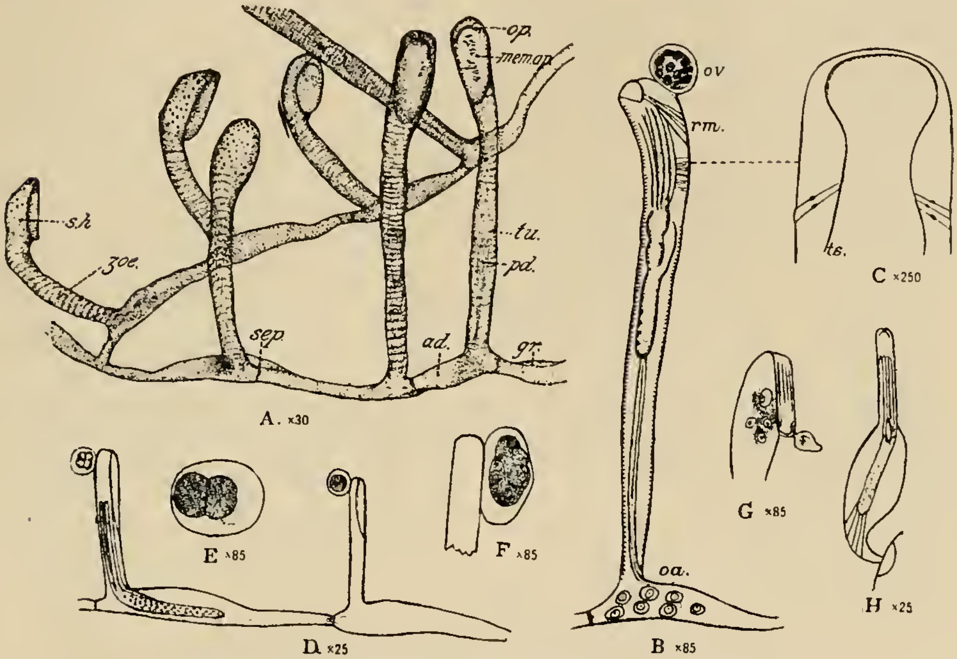


Fig. 47.—Family Aeteidae Smitt, 1867.

A–C. *Aetea anguina* Linnaeus, 1758. A. Portion of a zoarium, × 30, illustrating structure. (After Robertson, 1905.) *ad*, adherent portion; *gr*, groove; *mem. ap*, membraneous aperture; *op*, operculum; *pd*, polypide; *sep*, septum; *tu*, tubular part of the zooecia; *zoe*, zooecium. B. Sketch, × 85, showing the ovicell (*ov*) at the end of the tubular projection; the retractor muscles (*rm*) attached just below the tentacles, and also attached at the other end near the commencement of the basal expansion where the ovaria (*oa*) also occur. C. Front view, × 250, showing the operculum and tentacular sheath (*ts*) to which the muscles are attached. (B, C after Waters, 1913.)

D–H. *Aetea recta* Hincks, 1862. D. Drawing, × 25, showing ovicell at end of tubular part of zooecia. E, F. Two sketches of ovicells, × 85. G. Sketch, × 85, showing that the ovarium fills up most of the lower portion of the zooecium, and the tubular prolongation which is bent back carries an ovicell. H. Sketch, × 25, showing the position of the polypide in the zooecium. (D–H after Waters, 1897.)

On the fossils we seldom find more than the creeping portions of the zooecia, which give the appearance of a network of false stolons; the free part then lying on the substratum becomes fossilized very rarely. We have found two zoaria which in the thickness of their zooecia appear to correspond to *Aetea anguina*. Moreover, one of them retained an entire zooecium which seemed to us to agree exactly with the figure of the species given by Waters in 1913 in his work on the Marine Fauna of British East Africa and Zanzibar. Unfortunately, in cleaning the specimen a stroke of the brush destroyed it, leaving our determination doubtful.

*Occurrence.*—Upper Jacksonian (Ocala limestone): Ocala, Florida (rare); Bainbridge, Georgia (rare).

*Geological distribution.*—Helvetian of Egypt and France (Canu); Zanclean of Italy (Seguenza); Plaisancian of Italy (Manzoni, Neviani); Sicilian of Italy (Seguenza, Neviani); Quaternary of Italy (Neviani).

*Habitat.*—Eastern Atlantic, from the Gulf of Gascony to Norway; Mediterranean, France, Italy, and the Adriatic; Pacific, Australia, California; Indian Ocean, African coast.

The species inhabits the region of the laminarian seaweeds. It seldom lives at a depth greater than 30 meters.

*Plesiotype.*—Cat. No. 63948, U.S.N.M.

### AETEA cfr. TRUNCATA Landsborough, 1852.

Plate 32, fig. 1.

Cfr. 1852. *Anguinaria truncata* Landsborough, History of British Zoophytes or Corallines, p. 228, pl. 16, fig. 57.

The figure on plate 32 represents a specimen from Wilmington, North Carolina, which in the thinness of its stolons is quite similar to *Aetea truncata* Landsborough, 1852. However, it is impossible to make a definite determination without an entire zooecium.

*Occurrence.*—Middle Jacksonian (Castle Hayne limestone): Wilmington, North Carolina (rare).

*Plesiotype.*—Cat. No. 63947, U.S.N.M.

## Family SCRUPOCELLARIIDAE Levinsen, 1909.

*Bibliography (Anatomical).*—1865, Smitt, Om Hafs-Bryozoernas utveckling och fettkroppar. Öfversigt Kongl. Vetenskaps-Akademiens Förhandlingar, vol. 22, p. 8, pl. 1, figs. 13, 14; pl. 6, figs. 5, 6; pl. 7, figs. 1, 2, 5, 6.—1871, Claparede, Beiträge zur Anatomie und Ent-Wickelungsgeschichte der Seebryozoen, Zeitschrift für wissenshaftliche Zoologie, vol. 21, pl. 9, fig. 1; pl. 10, fig. 2.—1877, Barrois, Recherches sur l'embryologie des Bryozoaires. Travaux Institut Zoology, Lille, fasc. 1, pl. 10, figs. 2, 4, 8.—1888, Jullien, Mission scientifique du Cap Horn, 1882–83, vol. 6. Zoologie, p. 69, pl. 8, figs. 1–3.—1892, Waters, Observations on the gland-like bodies in the Bryozoa, Journal Linnean Society, London, Zoology, vol. 24, p. 277.—1896, Waters, Notes on the Bryozoa from Rapallo and other Mediterranean localities, chiefly Cellulariidae, Journal Linnean Society, Zoology, vol. 26, pl. 1, figs. 11, 12.—1900, Calvet, Contrib. a. l'historie naturelle des Bryozoaires ectoproctes marins Travaux Institut de Zoologie de Université de Montpelier, Mem. No. 8, pl. 11, figs. 7–9.—1904, Waters, Exped. Antarctic Belge Bryozoa, p. 25.—1913, Waters, Marine Fauna of British East Africa and Zanzibar, Bryozoa, Cheilostomata, Proceedings Zoological Society, London, p. 472, pl. 49, figs. 7–14.—1909, Levinsen, Morphological and Systematic Studies on the Cheilostomatous Bryozoa, p. 140.

The zooecia have large opesia. A gymnocyst and a cryptocyst are more or less developed. The mural rim bears distally one or two pairs of spines and laterally a membranous scutum. The distal wall, consisting of a horizontal, basal, and an obliquely ascending frontal part, has usually numerous small, scattered, uniporous septulae basally, while the distal half of each lateral wall has one multiporous septula. Besides dependent avicularia, found in most species, vibracula may also occur on the basal surface of the zoarium, and these are connected with the zoarium by an independent wall. The ovicells are generally hyperstomial. As a rule radicular fibers occur, sometimes springing from a septula (or a dietella), sometimes from a separate chamber connected with a vibraculum. The zoaria are always free, very branched, most frequently with uni- or few-seried zooecia, generally consisting of a single layer and in most cases jointed by means of chitinous transverse belts. (After Levinsen, 1909).

Figure 49 gives a summary of the most important anatomical features in this family. No trace of the scutum is left on the fossil forms, but its presence is revealed by a small pore situated on the mural rim. American Tertiary specimens are rare, small, and very fragile, and as a result we have been unable to make any detailed studies of the family.

The principal genera of this family are:

*Caberea* Lamouroux, 1816.
*Caberiella* Levinsen, 1909.
*Canda* Lamouroux, 1816.
*Scrupocellaria* Van Beneden, 1844.
*Bugulopsis* Verril, 1879.
*Hoplitella* Levinsen, 1909.
*Rhabdozoum* Hincks, 1882.
*Menipea* Lamouroux, 1816.

The two genera *Caberea* and *Scrupocellaria* alone are represented in the American collections studied. *Canda* and *Scrupocellaria* are very similar. Levinsen distinguishes these genera by their ovicells and Waters by their articulation.

### Genus SCRUPOCELLARIA Van Beneden, 1844.

1844. *Scrupocellaria* Van Beneden. Recherches sur l'organisation des Laguncula et l'histoire naturelle des differents Polypes Bryozoaires, Nouveaux Memoires de l'Academie Royale de Bruxelles, vol. 18, p. 44.

Zoarium jointed. Zooecia numerous in each internode, rhomboid; opesia with or without scutum; a sessile avicularium at the upper, outer, lateral angle, a vibraculum at the lower outer angle, and generally a sessile avicularium on the front surface of each zooecium. (Robertson.)

*Accepted genotype.*—*Scrupocellaria scruposa* Linnaeus, 1758.

*Range.*—Lutetian-Recent.

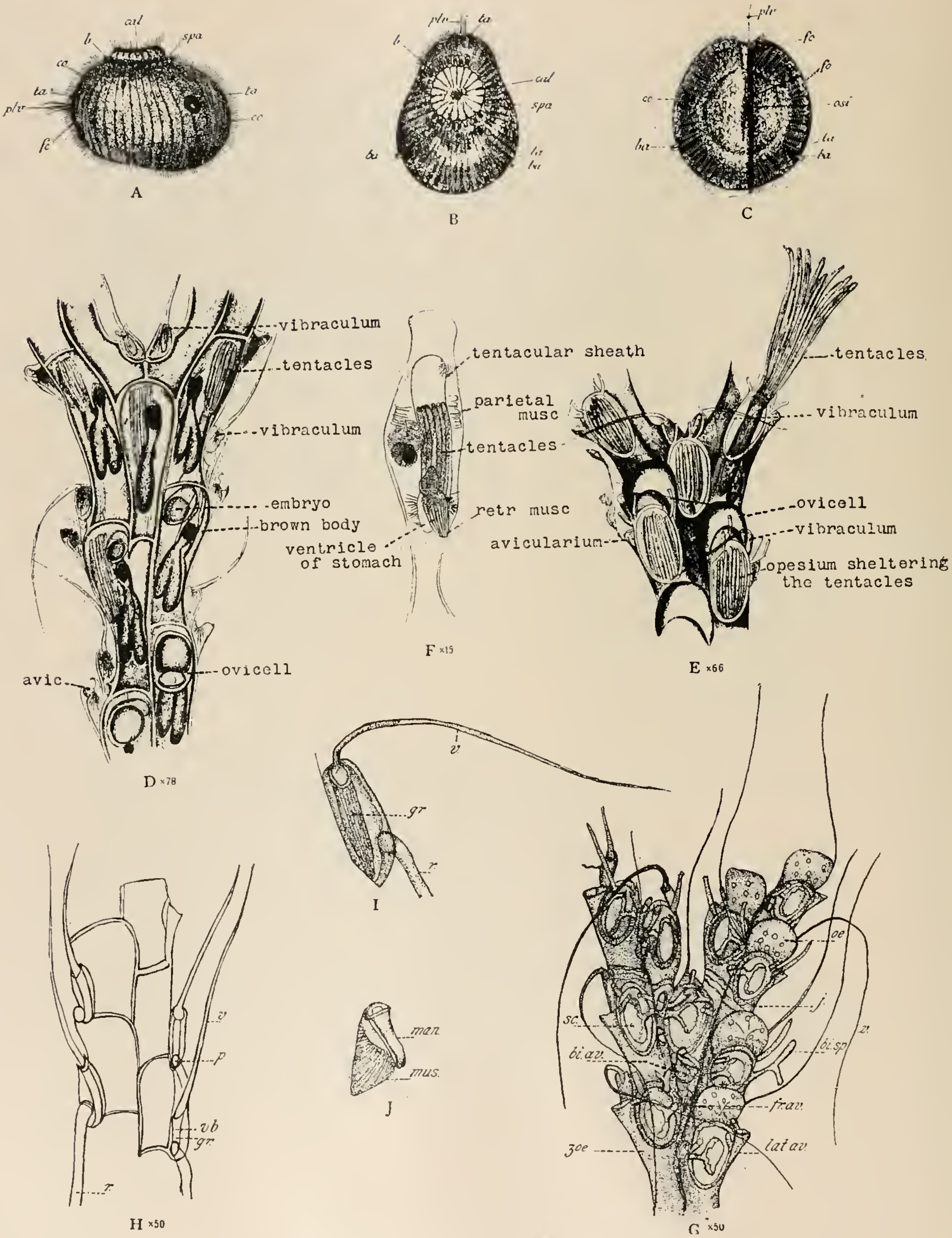

A
B
C
D ×78
E ×66
F ×15
G ×50
H ×50
I
J
cil
b
spa
co
ta
plv
fc
cc
fo
asi
bu
vibraculum
tentacles
embryo
brown body
ovicell
avic
tentacular sheath
parietal musc
retr musc
ventricle of stomach
avicularium
opesium sheltering the tentacles
v
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Fig. 48.—Family Scrupocellariidae Levinsen, 1909.

Fig. 48.—Family Scrupocellariidae Levinsen, 1909.

A–E. *Scrupocellaria scruposa* Linnaeus, 1758. A. Left lateral side of larva. B. Dorsal face of same. C. Ventral or oral face. (A–C after Calvet, 1900.) *b*, superior vesicular collar; *ba*, palette or pigmentary spots; *cal*, calotte (terminal bud); *co*, corona; *fc*, ciliated furrow; *fo*. ventral or oral face; *plv*, vibratile plume; *osi*, orifice of the internal sack; *spa*, palleal furrow; *ta*, pigmentary spots. D. Portion of a zoarium, showing structure, × 78. E. Another portion, × 66. (D–E after Claparede, 1870.)

F. *Menipea benemunita* Busk, 1884. Sketch showing anatomy. (After Jullien, 1888.)

G–J. *Scrupocellaria diegensis* Robertson, 1905. G. Portion of a branch, × 50, showing form of zooecia (*zoe*), with large scutum (*se*), spines on the upper margin of the aperture or opesium, one or more of which are bifid (*bi. sp*); also lateral avicularium (*lat. av*) and frontal avicularium on the zooecium at bifurcation (*bi. av.*). On those zooecia not possessing ooecia the vibracular chamber, plainly visible with its long vibraculum (*v*). H. Dorsal view of a few zooecia, × 50, to show vibracular chamber (*v. b.*) sustaining the long vibraculum (*v*) at its summit, and showing the groove (*gr*) extending in the direction of the length of the zooecia. At the base of the vibracular chamber, and to one side of the groove, is the pore (*p*) from which the root fiber, or radicell (*r*) extends (*fr. av*) frontal avicularium, (*j*) joint, (*oe*) ooecium. I. A vibracular chamber, enlarged, to show detail. J. The avicularium on zooecium at bifurcation, enlarged to show its large muscular portion (*mus*) and the obliquely directed mandible (*man*). (G–J after Robertson, 1905.)

### SCRUPOCELLARIA ELLIPTICA Reuss, 1869.

Plate 32, figs. 4–7.

1869. *Scrupocellaria elliptica* Reuss, Die fossilen Anthozoen und Bryozoen der Schichtengruppe von Crosaro, Denkschriften der k. Akademie der Wissenschaften, vol. 29, I Abth. p. 48, pl. 29, fig. 3.

1891. *Scrupocellaria elliptica* Waters, North Italian Bryozoa, Quarterly Journal of the Geological Society of London, vol. 47, p. 6, pl. 1, figs. 16, 17.

*Not* 1847. *Bactridium ellipticum* Reuss, Die fossilen Polyparien des Wiener Tertiärbeckens, Haidinger's naturwissenschaftliche Abhandlungen, vol. 2, p. 56, p. 9, figs. 7, 8.

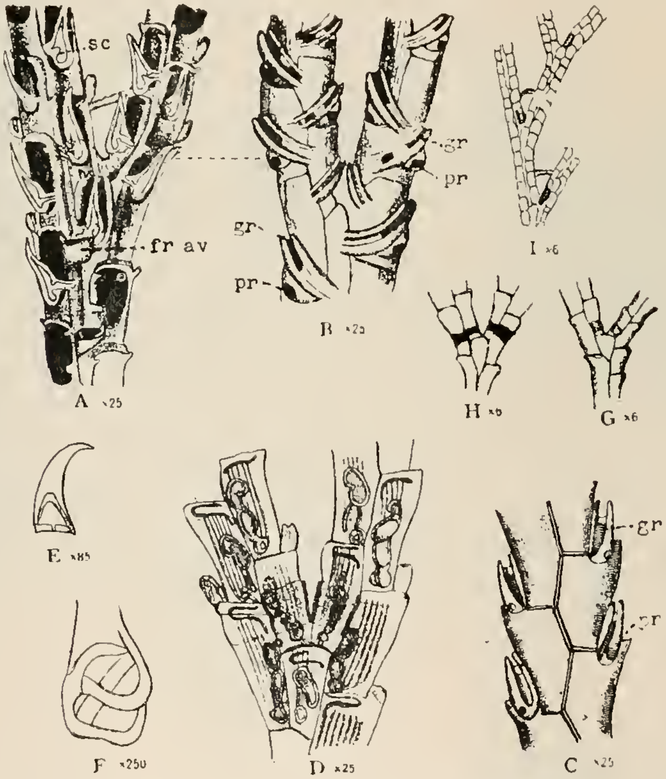

Fig. 49—Genus *Scrupocellaria* Van Beneden, 1844.

A, B. *Canda retiformis* Pourtales, 1867. Celluliferous and dorsal surfaces, × 25.

C–G. *Scrupocellaria ferox* Busk, 1852. C. Dorsal surface, × 25. *fr. av*, frontal avicularium; *gr*, groove; *pr*, radicular pore; *sc*, scutum. D. Decalcified piece, × 25, showing the articulation with the chitinous tube already formed on the inside zooecia of the new branch. Polypides and tentacles are visible. E. Mandible, × 85. F. Base of vibracular seta, × 250. G. Dorsal surface, showing the articulation, × 6.

H. *Scrupocellaria jalloisii* Audouin, 1826. Dorsal surface, × 6, to show the articulation with two chitinous tubes.

I. *Canda retiformis* Pourtales, 1867. Dorsal surface, showing simplest form of articulation, × 6. (A–I after Waters, 1913.)

In 1847 Reuss discovered in the Vienna Miocene a species which he called

In 1847 Reuss discovered in the Vienna Miocene a species which he called

Vicentin, Italy, in 1869. In comparing the excellent figures of Waters with the more reliable illustrations published by Reuss in 1874, it becomes probable that we are dealing with two distinct species. In 1875 Manzoni believed he had discovered the *Scrupocellaria elliptica* Reuss, 1874, in the Italian Plaisancian: his imperfect figure certainly led Sequenza and Neviani later into error. Finally the latter figured in 1900, still under this same name, a species undoubtedly distinct. The great geological distribution given by various authors to *Scrupocellaria elliptica* appears then to be erroneous.

In 1887 Pergens identified Reuss's species with *Scrupocellaria scruposa* Linnaeus, 1758. This was an erroneous identification which, followed by Miss Jelly, introduced a grave error in her Synonymic Catalogue of Marine Bryozoa. In 1880 Hincks believed he had found the same species living in English waters, but Waters thought that these specimens belonged to *Scrupocellaria inermis* Norman.

Our specimens agree with the figures published by Waters in 1891. Under the circumstances we believe it best to separate the Eocene species under the name *Scrupocellaria elliptica* Reuss, 1869. Future studies will be necessary before the status and name of the Miocene species can be determined.

*Description.*—The small frontal avicularium is rather constant and is without a pivot. The same features hold for the distal avicularium. The dorsal vibraculum is transverse, conforming to the figure given by Waters. Immediately below this is the radicular pore. The impression of the scutum is visible. The micrometric measurements are as follows:

*Measurements.*—Zooecia $\begin{cases} Lz = 0.46\text{–}0.50 \text{ mm.} \\ lz = 0.18\text{–}0.20 \text{ mm.} \end{cases}$ Opesia $\begin{cases} ho = 0.24\text{–}0.28 \text{ mm.} \\ lo = 0.10\text{–}0.12 \text{ mm.} \end{cases}$

*Occurrence.*—Middle Jacksonian: Wilmington, North Carolina (very rare); near Lenuds Ferry, South Carolina (very rare).

*Geological distribution.*—Priabonian of Vicentin, Italy (Reuss, Waters), and possibly in the Rupelian of Gaas, France (Reuss).

*Plesiotypes.*—Cat. Nos. 63950, 63951, U.S.N.M.

### SCRUPOCELLARIA GRACILIS Reuss, 1869.

Plate 32, figs. 8, 9.

1869. *Scrupocellaria gracilis* REUSS, Die fossilen Anthozoen und Bryozoen der Schichtengruppe von Crosaro, Denkschriften der k. Akademie der wissenschaften, Wien, vol. 29, p. 260, pl. 29, fig. 4.

1891. *Scrupocellaria gracilis* WATERS, North Italian Bryozoa, Quarterly Journal Geological Society, London, vol. 47, p. 6, pl. 1, figs. 12, 13.

Comparison of our photograph with the figures published by Waters shows the great similarity of the American specimens with *Scrupocellaria gracilis*. The dorsal vibraculum is small and longitudinal. The figured segment bears no trace of the scutum. At its base are zooecia which have undergone total regeneration.

*Occurrence.*—Middle Jacksonian: Near Lenuds Ferry, South Carolina (very rare).

*Geological distribution.*—Priabonian of Vicentin, Italy (Reuss, Waters), and possibly in the Rupelian of Gaas, France (Reuss).

*Plesiotype.*—Cat. No. 63952, U.S.N.M.

### SCRUPOCELLARIA COOKEI, new species.

Plate 81, figs. 6–8.

*Description.*—The segments of this new species carry at a maximum 10–12 zooecia arranged alternately. The zooecia are distinct and elliptical; their mural rim is rounded, and bears a very small distal rounded avicularium, without a pivot; the frontal avicularium is larger and elliptical. On the dorsal side the zooecia are distinct and convex; the vibraculum is almost straight, pointed, and bears a small groove and a small radicular pore.

*Measurements.*—Opesia $\begin{cases} ho=0.28 \text{ mm.} \\ lo=0.12 \text{ mm.} \end{cases}$ Zooecia $\begin{cases} Lz=0.42 \text{ mm.} \\ lz=0.22\text{–}0.26 \text{ mm.} \end{cases}$

*Affinities.*—This species is distinguished from *Scrupocellaria elliptica* Reuss, 1869, by its greater breadth and its straight vibraculum. From *S. gracilis* it differs in its greater micrometric dimensions, the constancy of the frontal avicularium and the larger vibraculum; from *S. milneri* by its smaller dimensions and straighter and much smaller frontal avicularium. We have not found the pore or the pit indicating the presence of the scutum on any of the specimens, nor can we explain the meaning of the distal lamella observed in some opesia (fig. 6).

This fine species is dedicated to Dr. C. Wythe Cooke, of the United States Geological Survey, to whose painstaking efforts through several field seasons we are indebted for much of our choicest material from the Jacksonian and Vicksburgian of the Southern States.

*Occurrence.*—Vicksburgian (Marianna limestone): Salt Mountain, 5 miles south of Jackson, Alabama (common).

Vicksburgian (Red Bluff clay), 7½ miles southwest of Bladen Springs, Alabama (very rare).

Vicksburgian (Byram marl): Near Woodward, Wayne County, Mississippi (rare).

*Holotype.*—Cat. No. 64237, U.S.N.M.

### SCRUPOCELLARIA MILNERI, new species.

Plate 81, figs. 9–16.

*Description.*—The segments in this species are large and bear at a maximum 10–12 alternating zooecia. The zooecia distinct and elliptical; their mural rim rounded and bearing an inconspicuous distal avicularium, without pivot. The frontal avicularium is very large, oblique, acuminate, without pivot or denticle. On the dorsal the zooecia are a little convex; the vibraculum is oblique, rather large, and bears a quite distinct, prominent groove and a large radicular pore situated on a small convex chamber. The hyperstomial ovicell is situated on the gymnocyst of the distal zooecium.

*Measurements.*—Opesia $\begin{cases} ho=0.30\text{–}0.32 \text{ mm.} \\ lo=0.16\text{–}0.18 \text{ mm.} \end{cases}$ Zooecia $\begin{cases} Lz=0.42\text{–}0.46 \text{ mm.} \\ lz=0.26\text{–}0.30 \text{ mm.} \end{cases}$

*Affinities.*—The large size of its frontal avicularium and its greater micrometric dimensions clearly distinguish this species from *Scrupocellaria cookei*, with which it is associated.

No trace of a scutum has been found. nor has a reason been obtained to explain the opesial lamella shown on some zooecia. One of our specimens is a branching segment showing, as determined by Waters some time since, that the articulations are calcified in such cases. The dorsal is an olocyst with two separated layers (fig. 11).

This splendid species is named in honor of Mr. J. B. Milner, who has taken a keen interest in the bryozoa in his preparatory work upon the Tertiary fossils belonging to the United States Geological Survey and the United States National Museum, and who has found many specimens for our study.

*Occurrence.*—Vicksburgian (Marianna limestone): Salt Mountain, 5 miles south of Jackson, Alabama (rare): Murder Creek, east of Castleburv, Conecuh County, Alabama (very rare); west bank of the Conecuh River, 1 mile below mouth of the Sepulga River, Escambia County, Alabama (common).

Vicksburgian (Red Bluff clay): 7½ miles southwest of Bladen Springs, Alabama (rare).

*Cotypes.*—Cat. Nos. 64238–64240, U.S.N.M.

### SCRUPOCELLARIA RESSERI, new species.

Plate 81, figs. 20–23.

*Description.*—The segments are formed of at least 10 alternating zooecia. The zooecia are distinct, with or without an elliptical gymnocyst; the opesium elliptical; mural rim is salient, thick, rounded, and bears two distal spines; the distal avicularium is very large and triangular; the frontal avicularium is smaller, projecting its pointed end above. On the dorsal the zooecia are distinct and convex; the vibraculum is straight, salient, and provided with a rectilinear groove. The ovicell is hyperstomial and situated on the distal zooecium.

*Measurements.*—Opesia $\begin{cases} ho=0.20 \text{ mm.} \\ lo=0.10\text{–}0.12 \text{ mm.} \end{cases}$ Zooecia $\begin{cases} Lz=0.34\text{–}0.40 \text{ mm.} \\ lz=0.22\text{–}0.23 \text{ mm.} \end{cases}$

*Affinities.*—This species differs from both *Scrupocellaria cookei* and *S. milneri* in the rectilinear groove of its vibraculum which gives it a false resemblance to *Caberea*. The specific name is in honor of Mr. Charles E. Resser, of the United States National Museum, who has been of assistance to us in the preparation of the illustrations for this work.

*Occurrence.*—Vicksburgian (Glendon member of Marianna limestone): West bank of the Conecuh River, 1 mile below the mouth of the Sepulga River, Escambia County, Alabama (common).

*Cotypes.*—Cat. No. 64242, U.S.N.M.

### SCRUPOCELLARIA WILLIARDI, new species.

Plate 81, figs. 24–27.

*Description.*—The segments in this species are thick and bear at least 10 zooecia arranged alternately. The zooecia are not distinctly separated from each other, are pyriform and provided with a small proximal cryptocyst; their mural rim is rounded and with neither spines nor scutum; the distal aviculariun is very small and inconstant. On the dorsal the zooecia are indistinct; here the vibraculum is quite large and bears a broad groove adjacent to which is a radicular pore, projecting but little.

*Measurements.*—Opesia $\left\{\begin{array}{l} ho=0.26\text{ mm.} \\ lo=0.12\text{ mm.}\end{array}\right.$ Zooecia $\left\{\begin{array}{l} Lz=0.40\text{ mm.} \\ lz=0.28\text{ mm.}\end{array}\right.$

*Affinities.*—In its pyriform opesium this species is quite similar to the living *S. retiformis* Smitt, 1872, but it differs totally on account of its very large vibraculum, which above all is quite characteristic.

The specific name is in honor of our friend, Mr. Thomas E. Williard, of the United States Geological Survey, to whom we are indebted for many courtesies.

*Occurrence.*—Vicksburgian (Marianna limestone): Salt Mountain, 5 miles south of Jackson, Alabama (common).

Vicksburgian (Byram marl): Near Woodward, Wayne County, Mississippi (rare).

*Cotypes.*—Cat. No. 64243, U.S.N.M.

### SCRUPOCELLARIA TRIANGULATA, new species.

Plate 81, figs. 17–19.

*Description.*—The segments are narrow, *triangular* in cross section, and bear 12 to 14 zooecia arranged alternately. The zooecia are distinctly elliptical and are provided with a small proximal cryptocyst: the opesium is pyriform and narrowest anteriorly; the mural rim is rounded and bears trace of a scutum; the distal avicularium is simple and very small, while the frontal avicularium is quite rare. On the dorsal the zooecia are distinct and a little convex: the vibraculum is large, slightly oblique, acuminate, and provided with a long, very oblique groove; the radicular pore is prominent.

*Measurements.*—Opesia $\left\{\begin{array}{l} ho=0.20\text{ mm.} \\ lo=0.10\text{ mm.}\end{array}\right.$ Zooecia $\left\{\begin{array}{l} Lz=0.36\text{ mm.} \\ lz=0.28\text{ mm.}\end{array}\right.$

*Affinities.*—This species is closely related to *Scrupocellaria reticulata* Smitt, 1872, occurring in the waters off Florida. *S. triangulata* is distinguished, however, by its smaller dimensions, by the absence of the frontal avicularium and by its noncrenulated opesium.

*Occurrence.*—Vicksburgian (Glendon member of Marianna limestone): West bank of Conecuh River, 1 mile below mouth of Sepulga River, Escambia County, Alabama (rare).

*Holotype.*—Cat. No. 64241, U.S.N.M.

### SCRUPOCELLARIA RATHBUNI, new species.

Plate 81, figs. 30–32.

*Description.*—The segments are narrow and bear 10 alternating zooecia; their transverse section is triangular. The zooecia are distinct, oblique, slightly pyriform, and are without a cryptocyst; the opesium is pyriform and narrowest proximally; the mural rim is thin, rounded, and bears a short, hollow, projecting spine, which represents the scutum; the distal avicularium is simple and very small, but the frontal avicularium is very large and projecting, slightly oblique, with the point above and without pivot, but with two lateral denticles. On the dorsal, the zooecia are visible and convex; the avicularium is very oblique and terminates in a long spatulate groove; adjacent to it is a small projecting radicular pore.

*Measurements.*—Opesia $\begin{cases} ho=0.28 \text{ mm.} \\ lo=0.10 \text{ mm.} \end{cases}$

Zooecia $\begin{cases} Lz=0.44\text{–}0.48 \text{ mm.} \\ lz=0.24 \text{ mm.} \end{cases}$ (Not counting projection of avicularium.)

*Affinities.*—This species is excellently characterized by the large size and projection of its frontal avicularia, which give to the zoarium a very bristling aspect. Otherwise the species is very close to the living *S. retiformis* Smitt, 1872. It is remarkable to observe the occurrence of species of this type throughout the ages in the same waters of Florida.

The specific name of this very characteristic species is in honor of Dr. Richard Rathbun, late assistant secretary of the Smithsonian Institution, in charge of the United States National Museum, in appreciation of his work upon marine invertebrates.

*Occurrence.*—Vicksburgian (Glendon member of Marianna limestone): West bank of Conecuh River, 1 mile below the mouth of Sepulga River, Escambia County, Alabama (rare).

*Holotype.*—Cat. No. 64245, U.S.N.M.

### SCRUPOCELLARIA VAUGHANI, new species.

Plate 81, figs. 28, 29.

*Description.*—The segments are compressed and bear 10 alternating zooecia. The zooecia are distinct, oblique, elliptical, without cryptocyst, but with a small gymnocyst. The opesium is elliptical; the mural rim, thin and rounded, has a short, hollow, spine which is the trace of the articulation of the scutum. The frontal avicularium is small, little salient, triangular; the distal avicularium is large, triangular, without pivot and with a very sharp beak. On the dorsal side the zooecia are indistinct; the vibraculum is very large and triangular, whereas the radicular pore is very small.

*Measurements.*—Opesia $\begin{cases} ho=0.25 \text{ mm.} \\ lo=0.12 \text{ mm.} \end{cases}$ Zooecia $\begin{cases} Lz=0.45 \text{ mm.} \\ lz=0.22 \text{ mm.} \end{cases}$

*Affinities.*—This species is perfectly characterized by its distal avicularium, which is large and very salient. It differs from *Scrupocellaria elliptica* Reuss, 1869, in which the dorsal side is very similar, exactly in the quite different form of the distal avicularium.

We dedicate this splendid and remarkable species to Dr. T. Wayland Vaughan, under whose auspices the present work has been undertaken.

*Occurrence.*—Vicksburgian (Red Bluff clay): 7½ miles southwest of Bladen Springs, Alabama (very rare).

*Holotype.*—Cat. No. 64244, U.S.N.M.

### SCRUPOCELLARIA DUBIA, new species.

Plate 32, figs. 10–14.

*Description.*—The little fragments which we figure are hardly sufficient for the characterization of a species. The characters of the dorsal are quite distinct, but on the frontal side all of the zooecia observed appear to have undergone total regeneration. One of the segments seems to indicate the occurrence of chitinous joints, a condition which is not habitual in *Scrupocellaria.* The species necessitates further examination based upon numerous and better preserved specimens.

*Occurrence.*—Middle Jacksonian: Near Lenuds Ferry, Georgetown County, South Carolina (rare).

*Cotypes.*—Cat. No. 63953, U.S.N.M.

### SCRUPOCELLARIA CLAUSA, new species.

Plate 82, figs. 1–5.

*Description.*—The zoarium is formed of segments with 12 zooecia arranged alternately. The zooecia are distinct, elliptical, provided with a gymnocyst; the mural rim is very thin, salient. The opesium is elliptical. The distal avicularium is large, transverse, much projecting, without pivot or denticle. No frontal avicularium. The opesium is covered by a membrane with lateral ribs; apertura semilunate, with the proximal border concave. On the dorsal side the zooecia are distinct and convex; the vibraculum is straight and acuminate, and without groove; adjacent to it is a small radicular pore.

*Measurements.*—Opesia $\left\{\begin{array}{l} ho=0.20\text{–}0.26\text{ mm} \\ lo=0.10\text{ mm.}\end{array}\right.$ Zooecia $\left\{\begin{array}{l} Lz=0.36\text{–}0.40\text{ mm.} \\ lz=0.20\text{ mm.}\end{array}\right.$

Aperture $\left\{\begin{array}{l} ha=0.06\text{ mm.} \\ la=0.08\text{–}0.09\text{ mm.}\end{array}\right.$

*Affinities.*—This species belongs to the group of *S. marsupiata* Jullien, 1882,[1] a recent species dredged in the great depths of the Atlantic off the northwest coast of Spain and between the Azores and the Bermudas. The French author states that the membrane which closes the opesium is a flabelliform spine jutting forward. Therefore, it replaces the scutum, and its origin is the same. As the *Menipea clausa* Busk, 1884, is a synonym of *Scrupocellaria marsupiata*, this specific term is free for use for the present species. The false costules observed are only remains of the ramifications of the primitive spine. Our fossil species differs from the recent form in its smaller gymnocyst, its very salient distal avicularium, and its smaller micrometric dimensions.

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[1] Dragages du *Travailleur*, Bryozoaires; espèces draguées dans l'ocean atlantique en 1881, Bulletin Société Zoologique de France, vol. 7, pl. 13, figs. 17–20.

*Scrupocellaria marsupiata* Jullien has been found at depths of 2,018 and 2,713 meters, but these figures do not indicate the real habitat. These articulated species live more often attached to algae at the surface of the sea, and are deposited in the great depths after their death. We can not, therefore, consider these figures in restoring the bathymetric lines of the Eocene Gulf.

*Occurrence.*—Vicksburgian (Marianna limestone): Salt Mountain, 5 miles south of Jackson, Alabama (rare); west bank of Conecuh River, 1 mile below mouth of Sepulga River, Escambia County, Alabama (rare); Murder Creek, east of Castlebury, Conecuh County, Alabama (rare).

Vicksburgian (Bryam marl): West of Woodward, Wayne County, Mississippi (very rare).

*Cotypes.*—Cat. Nos. 64247, 64248, U.S.N.M.

### Genus CABEREA Lamouroux, 1816.

1816. *Caberea* Lamoroux, Historie des Polypiers Coralligenès flexibles.

Zoarium not articulated. Zooecia in two or more series, subquadrangular or ovate, with a very large aperture. Sessile frontal avicularia on the side and front of zooecia; lateral avicularia minute. Vibracular cells very large, placed in two rows stretching obliquely downward across the back of the zooecia, which they almost cover, to the median line, notched above and traversed through a great portion of their length by a shallow groove. Vibracula usually toothed on one side. (Robertson.)

*Genotype.*—*Caberea boryi* Audouin, 1826.

*Range.*—Vicksburgian-Recent.

#### CABEREA BORYI Audouin, 1826.

Plate 81, figs. 33, 34.

1826. *Crisia boryi* (Savigny) Audouin, Explication sommaire des planches de Polypes de l'Egypte et de la Syrie, in Savigny's Description de l'Egypte, Histore Naturelle, vol. 3, p. 73, pl. 12, fig. 4.

1880. *Caberea boryi* Hincks, British Marine Polyzoa, p. 61, pl. 8, figs. 9–11.

1889. *Caberea boryi* Jelly, A Synonymic Catalogue of Marine Bryozoa, p. 31. London (see for earlier references).

1892. *Caberea boryi* Waters, Observations on the gland-like bodies in the bryozoa, Journal Linnean Society, London, Zoology, vol. 24, p. 272.

1896. *Caberea boryi* Waters, Notes on the Bryozoa from Rapallo and other Mediterranean localities, chiefly Cellulariidae, Journal Linnean Society, London, Zoology, vol 26, p. 9.

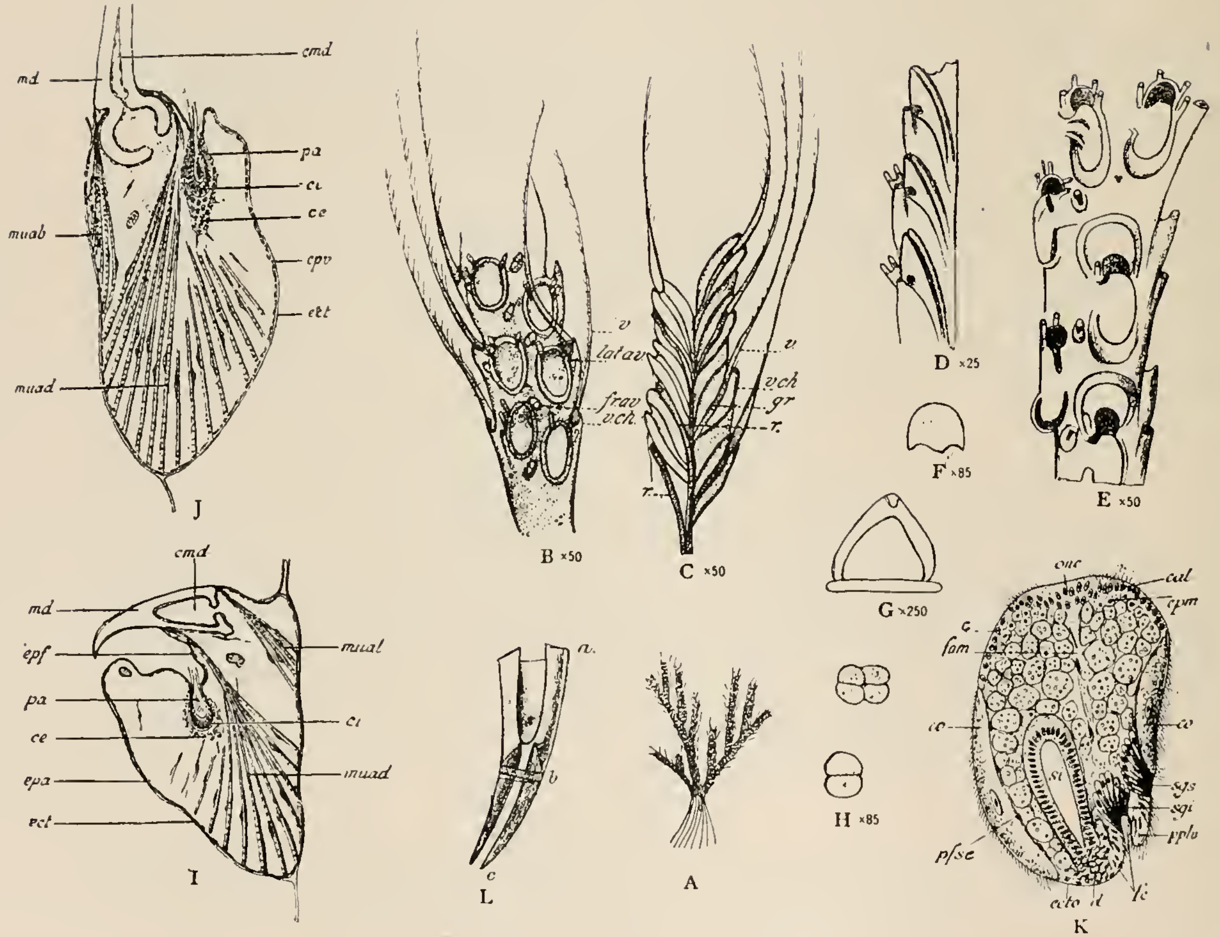
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FIG. 50.—Genus *Caberea* Lamouroux, 1816.

FIG. 50.—Genus *Caberea* Lamouroux, 1816.

A–C. *Caberea ellisi* Fleming, 1828. A. Zoarium, natural size. B, C. Anterior and posterior sides of a zoarium, × 50. (A–C, After Robertson, 1907.)

*fr. av.*, frontal avicularium.
*gr*, the groove.
*lat. av.*, the minute lateral avicularia.
*r*, the rootlets arising from each vibracular chamber and proceeding downward through the middle of the branch.
*v*, serrated vibraculum.
*v. ch.*, vibracular chamber visible from the front.
*v. ch.*, vibracular chambers extending obliquely across the back of each zooecium.

D–H. *Caberea darwini* Busk, 1884. D. Lateral surface, × 25. E. Anterior surface, × 50. F. Operculum, × 85. G. Avicularian mandible, × 250. H. Ova, out of the ovicell, × 85. (D–H, After Waters.)

I–K. *Caberea boryi* Audouin, 1826. I. Longitudinal section of an avicularium, greatly enlarged.

*ce*, external layer of the ciliated organ.
*ci*, internal layer of the same organ.
*cmd*, mandibular cavity.
*ect*, ectocyst.
*epa*, avicularian epiderm.
*epf*, facial epiderm.
*md*, mandible (=endocyst).
*muab*, abductor muscle of the mandible.
*muad*, adductor or retractor muscle of the mandible.
*pa*, aborted polypide=ciliated organ.

J. Longitudinal section of a vibraculum, greatly enlarged.

*cmd*, cavity of the vibraculum (=endocyst).
*ect*, ectocyst.
*epv*, vibracular epidermis.
*md*, vibraculoid mandible.
*muab*, abductor mandibular muscle.
*muad*, adductor mandibular muscle.
*pa*, aborted polypide=ciliated organ=peculiar body with *ci*, its internal layer and *ce*, its external layer.

K. Median sagittal section of an embryo at one of the last stages of its development. It presents almost the exact structure of the larva. (I–K. After Calvet, 1900.)

*c*, mantle.
*cal*, calotte (terminal bud).
*co*, corona.
*d*, vaginal diaphragm.
*ecto*, oral ectoderm.
*epm*, mesodermic thickening.
*fc*, ciliated cleft.
*fom*, neuro muscular bundles.
*onc*, central nervous organ.
*pfsc*, subectoderm nerve plexus.
*pplv*, papilla of the vibratile plume.
*sgi*, inferior glandular system.
*sgs*, superior glandular system.
*si*, internal sac.

L. *Caberea ellisii* Fleming, 1828. (After Waters.) Vibracular chamber seen from the inside. *a*, *b*, vibracular chamber; *b*, *c*, continuation of the groove beyond the chamber.

1909. *Caberea boryi* NORMAN, The Polyzoa of Madeira and neighboring islands, Journal Linnean Society, London, Zoology, vol. 30, p. 285.

1912. *Caberea boryi* CANU. Étude comparée des Bryozoaires Helvetiens de l'Egypte avec les Bryozoaires vivants de la Mediterranée et de la Mer Rouge, Memoires Institut Egyptien, vol. 6, p. 198, pl. 10, fig. 17 (gives paleontological references).

*Affinities.*—Our unique specimen appears to us correctly determined within the limits compatible with the extreme fragility of this small fossil. As in the fossil representative from Egypt, the opesium measures 0.20 mm. by 0.12 mm. Traces of the scutum are visible on almost all of the zooecia, which prevents this specimen from being identified with *Caberea ellisi* Audouin. We have not noticed the occurrence of distal spines. Therefore this is not *Caberea darwini* Busk. However, the small frontal avicularium placed near the zoarial axis appears more triangular.

*Occurrence.*—Vicksburgian (Glendon member of Marianna limestone): West bank of the Conecuh River, 1 mile below mouth of Sepulga River, Escambia County, Alabama (very rare).

*Habitat.*—Atlantic: Madeira Islands, English Channel, and British waters generally. Pacific: New Zealand and Australia. Mediterranean and Adriatic.

Although floating and parasitic on marine algae this species has been found in the Mediterranean at depths from 70 to 100 meters, but we are ignorant as to whether the specimens were living. The species has never been observed off either the Atlantic or Pacific coast of America, where it is replaced by *Caberea ellisi* Audouin, 1826. (Robertson, Osburn). Its presence in Madeira renders its discovery in Florida very probable.

*Geological distribution.*—Miocene of Australia (Waters); Helvetian of Egypt (Canu); Zanclean of Italy (Seguenza); Sicilian of Italy (Seguenza and Stefani); Quaternary of Italy (Seguenza, Neviani, Waters).

*Plesiotype.*—Cat. No. 64246, U.S.N.M.

## Family FARCIMINARIIDAE Busk, 1852.

The zooecia are furnished with an obliquely ascending distal wall and separated by common lateral walls, which are furnished with a small number (2–4) of uniporous septulae; no true spines. The avicularia dependent, sometimes depressed, sometimes strongly projecting. The ovicells are endozooecial. The zoaria are dichotomously branched tufts, with slender, prismatic, sometimes jointed segments, on which the zooecia are arranged in longitudinal rows (generally 4–6) around an axis formed by the adjoining separating walls. (After Levinsen, 1909.)

There have as yet been no anatomical researches on the representatives of the family.

The known genera are as follows, the last one alone being represented in our American collections:

*Columnaria* Levinsen, 1909.
*Farciminaria* Busk, 1852.
*Nellia* Busk, 1852.

We have added *Heterocella* Canu, 1907, to this family because it is not yet advisable to create a distinct family for it.

### Genus NELLIA Busk, 1852.

1852. *Nellia* BUSK, Catalogue Marine Polyzoa, British Museum, Cheilostomata, pt. 1, p. 18.

The zoaria are jointed. The zooecia are without spinous processes; the distal wall has at its inner corner a single septula; the ovicells are in almost their whole extent immersed into the proximal part of the ordinary zooecium and project only very little on the surface of this. The avicularia are attached by a wide base or partially immersed with calcareous transverse pivot. (After Levinsen, 1909.) 12 tentacles.

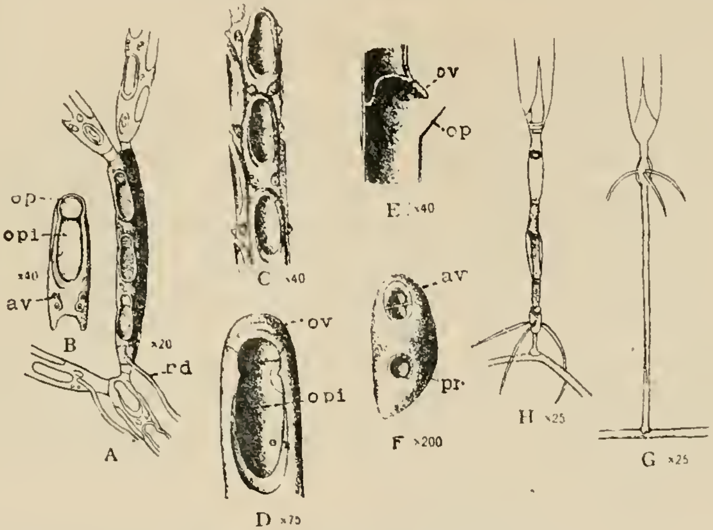

FIG. 51.—Genus *Nellia* Busk, 1852.

A–H. *Nellia oculata* Busk, 1852. A, B. Segment, × 20 and a zooecium × 40. (After Smitt, 1872.) C. Fragment, × 40. The two proximal zooecia to the left without ovicell. An avicularian chamber is seen through one of the lateral walls of the middlemost zooecium. D. A zooecium with ovicell, × 75. An uncalcified transverse belt is present. E. A longitudinal section through an ovicell, × 40. F. An avicularium with pit for the insertion of the radical fiber, × 200. (C–F, After Levinsen, 1909.) G, H. Stalk growing from stolon, × 25. The growth is from a spreading stolon from which, at intervals sub-colonies grow, commencing with short calcareous nodes joined by chitinous tubes, × 25. (After Waters, 1913.) *av*, avicularia; *ov*, ovicell; *op*, operculum; *opi*, opesia; *pr*, radicular pore; *rd*, radical fiber.

*Genotype.*—*Nellia oculata* Busk, 1852.

*Range.*—Jacksonian-Recent.

The genus *Nellia* of Busk is not the genus *Farcimia* of Pourtales. The type of the latter, *Farcimia cereus* Smitt, 1872, requires further examination.

### NELLIA OCULATA Busk, 1852.

Plate 82, figs. 6–10.

*Bibliography of living forms.*

1889. *Farcimia tenella* Jelly, A Synonymic Catalogue of Marine Bryozoa, p. 94 (cites general bibliography).

1909. *Farcimia oculata* Waters, Reports on the Marine Biology of the Sudanese Red Sea, Journal Linnean Society, London, Zoology, vol. 31, p. 167.

1913. *Farcimia oculata* Waters, Marine Fauna of British East Africa and Zanzibar, Bryozoa, Cheilostomata, Proceedings Zoological Society London, 1913, p. 489, pl. 67, figs. 8, 9.

1914. *Nellia oculata* Osburn, The bryozoa of the Tortugas Islands, Florida, Publication Carnegie Institution of Washington, No. 182, p. 191 (American bibliography).

*Bibliography of fossil forms.*

1883. *Membranipora oculata* Waters, Fossil Cheilostomatous Bryozoa from Muddy Creek, Victoria, etc., Quarterly Journal Geological Society, London, vol. 39, p. 434.

1895. *Farcimia oculata* MacGillivray, A Monograph of the Tertiary Polyzoa of Victoria. Transactions of the Royal Society of Victoria, vol. 4, p. 50, pl. 6, figs. 6, 7.

1907. *Farcimia tenella* Canu, Bryozoaires des terrains tertiaires des environs de Paris, Annales de Paleontologie, vol. 2, p. 20, pl. 11, figs. 36, 37.

1912. *Farcimia oculata* Canu, Étude comparée des Bryozoaires Helvetien de l'Egypte avec les Bryozoaires vivants de la Mediterranée et de la Mer Rouge, Memoires Institut Egyptien, vol. 1, p. 191, pl. 10, figs. 16, 19.

The American fossil specimens have not the delicacy of the recent species, the segments being generally a little larger. The same is true of the examples found in the Lutetian of France. The measurements are quite variable on the same segment. We consider the upper zooecia of a segment as the more normal; the measurements for these are as follows:

*Measurements.*—Opesia $\begin{cases} ho=0.30 \text{ mm.} \\ lo=0.10\text{–}0.12 \text{ mm} \end{cases}$ Zooecia $\begin{cases} Lz=0.40\text{–}0.50 \text{ mm.} \\ lz=0.20 \text{ mm.} \end{cases}$

Below the opesium there is sometimes a small isolated radicular pore. The lower zooecium is often incomplete and bears only a radicular pore. The ovicells are very difficult to distinguish.

*Occurrence.*—Vicksburgian (Marianna limestone): Salt Mountain, 5 miles south of Jackson, Alabama (abundant); Vicksburg, Mississippi (rare in the lower beds).

Vicksburgian (Byram marl): West of Woodward, Wayne County, Mississippi (rare); Byram, Mississippi (rare).

*Geological distribution.*—Lutetian of the Paris Basin (Canu); Helvetian of Egypt (Canu); Miocene of Australia (MacGillivray).

*Habitat.*—Pacific: Australia, Crozet Island and the Philippines. Indian Ocean: Off Ceylon, Mergui Archipelago, Zanzibar, and in the Red Sea. Atlantic: Off Florida, St. Thomas, and the Tortugas.

Specimens have been dredged from a depth of 17 to 450 meters. Off the Tortugas Islands Osburn mentions that it is abundant on sponges from 20 to 28 meters. The Tertiary Gulf was certainly deeper than to-day and for this reason fossil examples are rare.

*Plesiotypes.*—Cat. Nos. 64249, 64250, U.S.N.M.

### NELLIA BIFACIATA, new species.

Plate 32, figs. 15–19.

*Description.*—The segments are formed of four linear series, with five zooecia in each. The zooecia are distinct, constricted below, and provided with a much-developed gymnocyst bearing two small avicularia. The mural rim is thin, salient, and without cryptocyst. The opesium is somewhat oval, narrowest below; the two frontal avicularia are symmetrical, simple, and without pivot.

*Measurements.*—*Opesia* $\begin{cases} ho=0.26 \text{ mm.} \\ lo=0.08\text{–}0.10 \text{ mm.} \end{cases}$ Zooecia $\begin{cases} Lz=0.50 \text{ mm.} \\ lz=0.16\text{–}0.20 \text{ mm.} \end{cases}$

*Affinities.*—The four faces of the zoarium are not identical. There are two rows of broad zooecia and two narrower ones. This character primarily, in addition to the great development of the gymnocyst, clearly distinguishes this species from *Nellia oculata* Busk, 1852. The micrometric measurements are also smaller.

The specimens from the Jacksonian are a little smaller than those of the Vicksburgian, but all the other characters are absolutely similar.

The first of the lower zooecia of the segment is often radicular; the second is frequently regenerated. In figs. 15, 16 may be seen an ordinary zooecium transformed into a radicular zooecium; probably it contained no polypide. We have not had the opportunity to discover the ovicells.

*Occurrence.*—Lower Jacksonian (Moodys marl): Jackson, Mississippi (very rare).

Middle Jacksonian (Castle Hayne limestone): Wilmington, North Carolina (rare).

Vicksburgian (Glendon member of Marianna limestone): West bank of Conecuh River, 1 mile below mouth of Sepulga River, Conecuh County, Alabama (rare).

Vicksburgian (Byram marl): Byram, Mississippi (rare).

*Cotypes.*—Cat. Nos. 63954, 63955, U.S.N.M.

### NELLIA CONCATENATA Canu, 1907.

Plate 32, figs. 20, 21.

1907. *Farcimia concatenata* Canu, Bryozoaires des terrains tertiaires des environs de Paris, Annales de Paleontologie, vol. 2, p. 19, pl. 11, figs. 1–4.

Of this species we have found only the two figured fragments which have been compared directly with specimens from the vicinity of Paris, with the result that their identity can not be doubted.

The large dimensions of *Nellia concatenata* clearly distinguishes it from the two preceding, *Nellia oculata* Busk and *N. bifaciata*.

*Occurrence.*—Middle Jacksonian: One-half mile southeast of the Georgia Kaolin Company's mine, Twiggs County, Georgia (very rare).

*Plesiotypes.*—Cat. No. 63956, U.S.N.M.

### NELLIA MIDWAYANICA, new species.

Plate 4, figs. 10–15.

*Description.*—The zoarium is articulated and radicellate. Each segment is quadrangular and formed of straight zooecia arranged in four series equal, two by two. The zooecia are rectangular; the opesium is anterior, elliptical, and is surrounded by a thin mural rim projecting but little; the gymnocyst (?) is well developed and bears two symmetrical tuberosities, which represent small avicularia opening laterally in the same plane as the adjacent rows; the two distal avicularia visible in the neighborhood of the opercular valve also match those of adjacent rows. Ovicell endozooecial.

*Measurements.*—Large opesia $\left\{\begin{array}{l} ho=0.26\text{–}0.36 \text{ mm.} \\ lo=0.12\text{–}0.14 \text{ mm.} \end{array}\right.$ Large zooecia $\left\{\begin{array}{l} Lz=0.44 \text{ mm.} \\ lz=0.40 \text{ mm.} \end{array}\right.$

*Affinities.*—This is a very curious species, which is difficult to classify. We have placed it in *Nellia* because of its great resemblance to *Nellia appendiculata* Hincks. 1883, a living species from Australia, and to *Farcimia articulata* MacGillivray, 1895.

It is also close to *Quadricellaria ventricosa* Canu, 1913, of the Girondin Lutetian of France; only the absence of a little distal crescent distinguishes it from this European species.

When we know the chitinous appendages of these two species perhaps it will become necessary to place them in a new genus with *N. appendiculata.*

There are two rows of broad zooecia opposite each other, and two rows of similarly placed narrow zooecia. At the base of certain opesia, exteriorly or interiorly, there is sometimes a radicular pore; such zooecia, therefore, bear at the same time a polypide and a radicular fiber.

As we have found this species in the three Midway localities studied, it seems to be a characteristic form and is thus deserving of the name applied to it.

*Occurrence.*—Midwayan (Clayton limestone): Mabelvale, near Little Rock, Arkansas (very rare); 1 mile west of Fort Gaines, Georgia (very rare); Luverne, Crenshaw County, Alabama (common).

*Cotypes.*—Cat. Nos. 63800, 63801, U.S.N.M.

## Genus HETEROCELLA Canu, 1907.

1907. *Heterocella* Canu, Bryozoaires des terrains tertiares des environs de Paris, Annales de Paleontologie, vol. 2, p. 14.

The zoarium is articulated with each segment formed of four rows of zooecia. The opesia are always oblique; they are small on the converging zooecia and large on the diverging ones. On the olocyst at the bottom of the zooecia there are impressions of various forms.

*Genotype.*—*Vincularia fragilis* Defrance, 1820.

In Europe this genus has been observed only in the French Lutetian. Its structure is still problematical, for no existing species is comparable to these fossil forms. Some of the zooecia described by Canu as regenerated are perhaps radicular.

### HETEROCELLA VICKSBURGICA, new species.

Plate 82, figs. 11–14.

*Description.*—The segments are quadrangular, straight, or slightly curved. The zooecia are distinct and rectangular; the mural rim is rounded, projecting distally, and enlarged proximally; the opesium is oval shaped and a little oblique. The length of the zooecium is 0.60 to 0.70 mm.

*Affinities.*—This species may be distinguished from *Heterocella fragilis* Defrance, 1820, by its greater micrometric dimensions, its straighter zooecia, and its smaller septulae.

*Occurrence.*—Vicksburgian (Marianna limestone): Salt Mountain, 5 miles south of Jackson, Alabama (common).

*Cotypes.*—Cat. No. 64251, U.S.N.M.

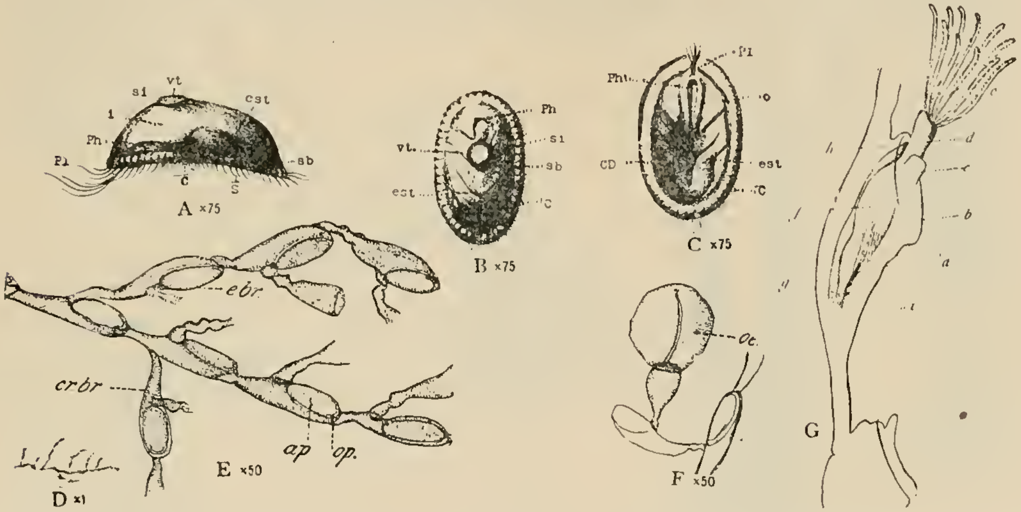

Fig 52.—Family Eucratiidae Hincks, 1880.

A–G. *Eucratea chelata* Linnaeus, 1758. A. Free larva viewed in profile; the terminal bud is much reduced, the aboral face well developed, and the oral face completely flat, × 75. B. Aboral face of larva showing the very simple terminal bud and the stomach visible even from the side, × 75. C. Larva, oral face, showing the trilobate form of the stomach, × 75. (A–C after Barrois, 1877.) *c*, corona; *CD*, digestive cavity; *cst*, stomach; *i*, aboral face; *ph*, pharynx; *pl*, ciliary plume; *o*, mouth of the gastrula; *s*, oral face; *sb*, furrow separating the aboral mass and funnel-shaped side; *si*, furrow separating the terminal bud and the lower portion of the aboral face; *vt*, terminal bud. D. Zoarium, natural size. E. Portion of a zoarium, × 50, showing the structure of the zooecia and method of branching (*e. br*) just below the opesia (*ap*) and the creeping branches (*cr. br.*) given off from the sides of the zooecia; (*op*) operculum. (After Robertson, 1905.) F. Sketch, × 50, showing ovicell (*oc*) on a small aborted zooecium. (After Hincks, 1880.) G. Anatomical structure of a zooecium. (After Milne-Edwards, 1838.) *a*, zooecium; *b*, opesium; *c*, opercular valve; *d*, tentacular sheath; *e*, ciliated tentacles; *f*, stomach; *g*, stomachic coecum; *h*, anus; *i*, retractor muscles of the polypide.

## Family EUCRATIIDAE Hincks, 1880.

Zoarium forming slender, branching, phytoid tufts. Zooecia uniserial or in two series placed back to back; expanding from the base upwards, with a terminal or subterminal and usually oblique opesium. Neither avicularian nor vibracular appendages known. Ovicell globose, hyperstomial. (Robertson.)

The genera of this family are:

| | |
|---|---|
| *Eucratea* Lamouroux, 1812. | *Huxleya* Dyster, 1858. |
| *Gemellaria* Savigny, 1811. | *Brettia* Dyster, 1858. |
| *Scruparia* Hincks, 1880. | |

### Genus GEMELLARIA Savigny, 1811.

1811 *Gemellaria* SAVIGNY, Iconographie des Zoophytes de l'Egypte.

Zoarium erect, branching dichotomously, each branch given off from the sides of the zooecia close to their upper extremity. Zooecia joined back to back and each pair arising from the anterior extremity of the preceding pair. Opesia large sloping slightly upward. Ovicell ? (Robertson.)

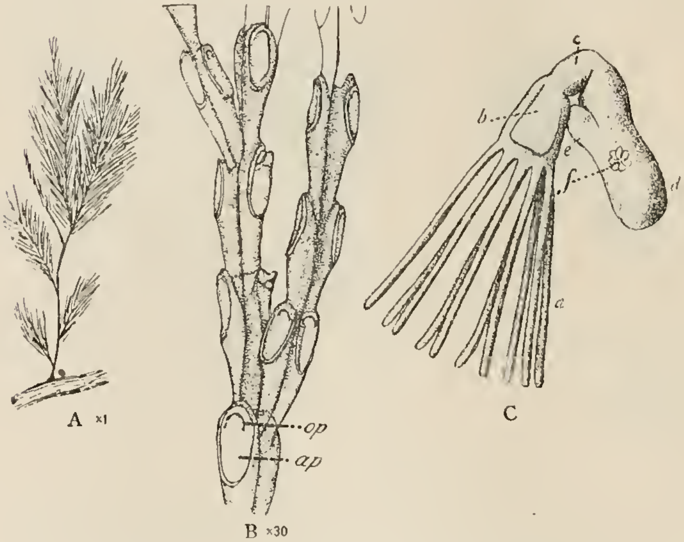

FIG. 53.—Genus *Gemellaria* Savigny, 1811.

A–C. *Gemellaria loricata* Linnaeus, 1778. A. Sketch of growth habit, natural size. B. Portion of a branch, × 30, to show arrangement of zooecia and method of branching; *ap*, aperture; *op*, operculum. (A, B after Robertson, 1907.) C. Anatomical structure of a zooecium. (After Van Beneden, 1845.) *a*, tentacles; *b*, pharynx; *c*, oesophagus; *d*, stomach; *c*, intestine; *f*, particles contained in the stomach.

#### GEMELLARIA PRIMA Reuss, 1865.

Plate 32, figs. 22–24.

1865. *Gemellaria prima* REUSS, Foraminiferen, Anthozoen und Bryozoen des deutschen septarienthones, Denkschriften der k. Akademie d Wissenschaften, vol. 25, p. 54, pl. 7, figs. 6, 7.

*Affinities.*—The first species of this genus found fossil is *Gemellaria* (*Dittosaria*) *wetherelli* Busk, 1866, of the English Londinian; it was figured anew in 1892 by Gregory under the name of *Notamia wetherelli.* The figures of Busk and of Gregory do not at all coincide. However our American species differs from it in the absence of areolae.

It differs also in the same character from *Gemellaria punctata* Seguenza, 1879, from the Helvetian of Italy.

The eight fragments which we have found do not permit a detailed study. It seems to us however—(1) that the genus *Dittosaria* Busk, 1866, ought to be maintained for the three known fossil species; (2) that their place in the Anasca is doubtful; (3) that this family, of which the larva is so near the Escharines, may be ranged in Ascophora in the vicinity of Catenariidae.

*Occurrence.*—Jacksonian (Zeuglodon zone): Cocoa post office, Choctaw County, Alabama (rare).

*Geological distribution.*—Rupelian (=Stampian) of Germany.

*Plesiotypes.*—Cat. No. 63957, U.S.N.M.

## Division II. COILOSTEGA Levinsen, 1909.

The parietal muscles are attached to the ectocyst and traverse the chitinous or partially calcified cryptocyst by means of the opesiules. The hydrostatic system is zoarial but each zooecium in addition is provided with a hypostege with the cryptocyst calcified.

The families of this division are as follows, all except the last three being represented in the present work:

Opesiulidae Jullien, 1888.
Subfamily Microporidae Hincks, 1880.
  Onychocellidae Jullien, 1881.
  Lunulariidae Levinsen, 1909.
Aspidostomidae Canu, 1908.
Steganoporellidae Levinsen, 1909.
Thalamoporellidae Levinsen, 1909.
Setosellidae Levinsen, 1909.
Chlidoniidae Levinsen, 1909.
Alysidiidae Levinsen, 1909.

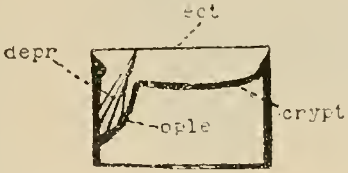

FIG. 54.—Structure of the Coilostega.

Diagrammatic transversal section of a zooecium of the Coilostega. (After Harmer, 1902.) *crypt*, calcified cryptocyst; *ect*, membranous ectocyst; *ople*, opesiule containing a depressor muscle (*depr*), or modified parietal muscle.

### Family OPESIULIDAE Jullien, 1888.

The parietal muscles are attached to the cryptocyst; their place is indicated either by pores or by lateral indentations called opesiules. The ovicell is endozooecial.

*Historical.*—In 1886 Jullien discovered that the parietal muscles in many genera of bryozoa were attached to the cryptocyst; these he grouped in the division Opesiulae (Coilostega Levinsen). His incomplete studies led him to conceive but a single family, the Opesiulidae. Successively other authors have erected the following families:

Steganoporellidae Levinsen, 1909.
Aspidostomidae Canu, 1908.
Thalamoporellidae Levinsen, 1909.
Setosellidae Levinsen, 1909.
Microporidae Hincks, 1880.

In 1909 Levinsen discovered that in *Onychocella* the parietal muscles are also attached to the ectocyst, and as the ovicell here is also endozooecial, it became necessary to group the Onychocellidae with the Microporidae. Previous to this, Jullien had remarked that his genus *Woodipora* of the Opesiulidae had some incredible resemblances to the Onychocellidae. Finally, having observed the endozooecial ovicell in the Lunulariidae, we are obliged to group in the same family of the Opesiulidae, the three ancient families of the Microporidae, Onychocellidae, and

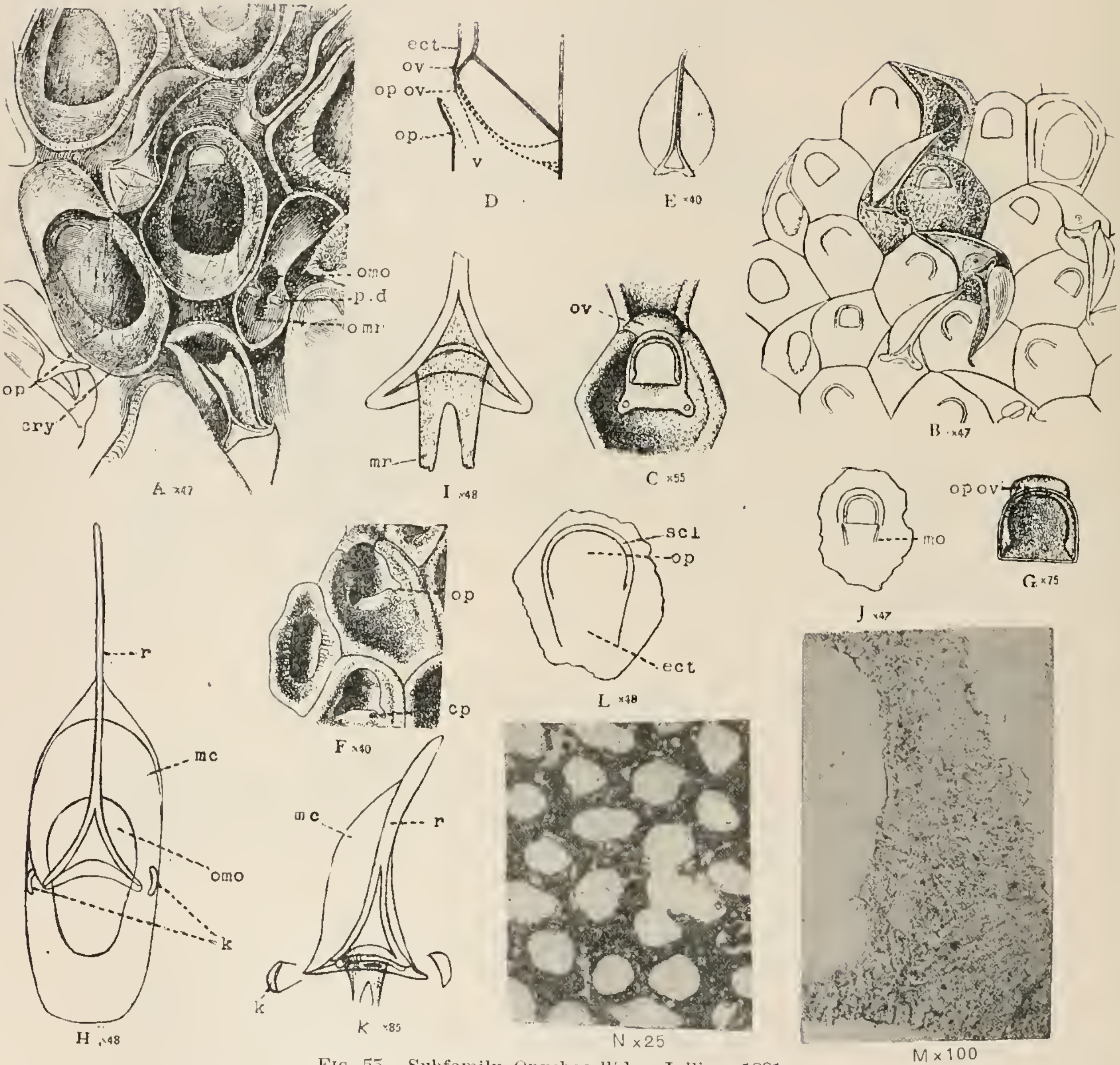
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Fig. 55.—Subfamily Onychocellidae Jullien, 1881.

Fig. 55.—Subfamily Onychocellidae Jullien, 1881.

A. *Onychocella luciae* Jullien, 1881. Portion of zoarium, × 47. B. *Onychocella marion* Jullien, 1881. Zooecia and onychocellaria, × 47. (A, B after Jullien.)

C–G. *Velumella levinseni* Canu and Bassler, 1917. C. Ovicelled zooecia, × 55. In the covering membrane of the aperture is seen a simple chitinized operculum, and in each of the two sinuses of the aperture the end of a parietal muscle. D. Longitudinal section through the endozooecial ovicell. E, F. Avicularium and mandible, × 40. G. A zooecial operculum, above which is an ooecial operculum. (C–G after Levinsen, 1909.)

H, I. *Rectonychocella solida* Nordgaard, 1907. Symmetrical mandible on the avicularium, × 48. (After Nordgaard, 1907.)

J. Opercular valve of *Onychocella luciae* Jullien, 1881, × 47.

K. *Onychocella angulosa* Reuss, 1847. Mandible, × 85. (After Waters, 1885.)

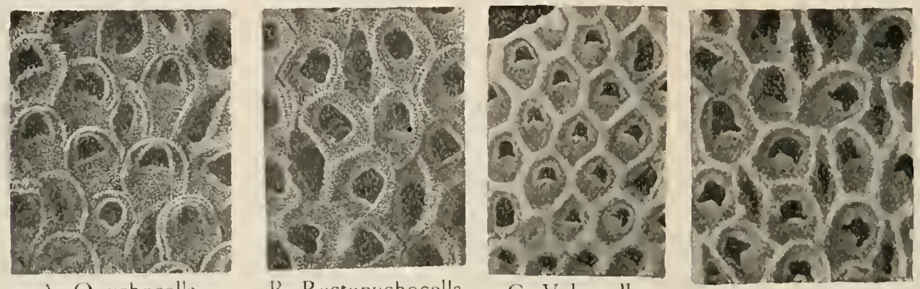
L. Opercular valve of *Rectonychocella solida* Nordgaard, 1907.

M. Microstructure of a zooecium of *Diplopholeos lineatum*, new species, × 100.

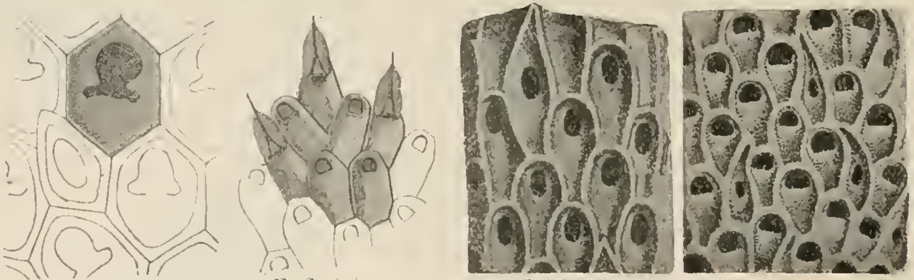
N. Vacuolar microstructure of an old zooecium of *Rectonychocella semiluna*, new species, × 25.

*cp*, polypidian convexity.
*cry*, cryptocyst.
*ect*, ectocyst.
*k*, lunate chitinous mass.
*mc*, corneous membrane.
*mo*, opercular muscles.
*mr*, elevator muscles of the mandible.
*omo*, passage of the occlusor muscles.
*omr*, passage of the elevator muscles of the mandible.
*op*, opesium.
*op*, opercular valve.
*op*, opesiular indentations.
*ov*, ovicell.
*opov*, operculum of the ovicell.
*pd*, pivot with denticles.
*r*, rachis.
*scl*, sclerite.
*v*, vestibulum.

Lunulariidae. Our generic tables show that it is absolutely impossible to class these genera with an endozooecial ovicell in different families; that they constitute a perfectly homogeneous assemblage; and that the secondary characters of the avicularium (adaptation) are the only characters for generic differentiation.



A Onychocella B Rectonychocella C. Velumella D. Diplopholeos



E. Floridina F. Smittipora G. Ogiva H. Ogivalia

Fig. 56.—Genera of the subfamily Onychocellidae Jullien, 1888.

A. *Onychocella angulosa* Reuss, 1847, × 20. Middle Jacksonian, Wilmington, North Carolina.

B. *Rectonychocella semiluna*, new species, × 20. Middle Jacksonian, Wilmington, North Carolina.

C. *Velumella levigata*, new species, × 20. Upper Jacksonian, West Bank of Sepulga River, Escambia County, Alabama.

D. *Diplopholeos fusiforme* Canu and Bassler, 1917, × 20. Middle Jacksonian, Wilmington, North Carolina.

E. *Floridina antiqua* Smitt, 1872. Recent.

F. *Smittipora abyssicola* Smitt, 1872. Recent.

G. *Ogiva actaca* D'Orbigny, 1852. Cretaceous (Senonian), Fecamp, France.

H. *Ogivalia cypraca* D'Orbigny, 1852. Cretaceous of France.

## Subfamily ONYCHOCELLIDAE Jullien, 1881.

*Bibliography* (*anatomical*)—1881, Jullien, note sur une nouvelle division des Bryoboaires Cheilostomiens, Bulletin Societe Zoologique de France, vol. 5, p. 7.—1890, Canu, Revision des Bryozoaires du Cretace figures par D'Orbigny, Bulletin Societé Geologique France, ser. 3, vol. 28, p. 383.—1909. Levinsen, Morphological and systematic studies on the Cheilostomatous Bryozoa, p. 153, pl. 22, fig. 3; pl. 24, fig. 10.

The ovicell is endozooecial. The parietal muscles are attached to the ectocyst. The cryptocyst is calcified. The avicularia are interzooecial and transformed into onychocellaria.

The cryptocyst is partially calcified. It bears laterally two opesiular indentations serving for the passage of the parietal muscles. Between them a semitubular projection forms the polypidian convexity protecting the tentacular sheath of the polypide. This convexity is an incomplete polypide tube which is found more perfected in the Thalamoporellidae and Steganoporellidae.

The onychocellarium which is always interzooecial, is a modified zooecium, and is also a complete avicularium. The axis of the mandible has one or two membranous expansions. All zooecial modifications cause a corresponding modification of the onychocellarium. Thus, when the retractor muscles of the polypide are attached in the inferior zooecial angles, the polypidian indentations are unsymmetrical and the onychocellarium also becomes unsymmetrical, having only one membranous expansion.

The pivot of the onychocellarium is formed by two strong lateral teeth dividing the opesium into two parts. The inferior part serves for the passage of the elevator muscles of the mandible; the superior part serves for the passage of the occlusor muscles of the mandible.

The operculum is an opercular valve surrounded by an arched, chitinous sclerite, which may or may not be distinct from the ectocyst.

The mural rim and the cryptocyst are both derived from the olocyst and formed of elements which group themselves in radiating series around the opesium (fig. 56M). The olocyst ceases in the old zooecia which become vacuolar (fig. 56N).

### Genus ONYCHOCELLA Jullien, 1881.

1881. *Onychocella* JULLIEN, Note sur une nouvelle division des Bryozoaires Cheilostomiens, Bulletin Société Zoologique France, vol. 6, p. 277.

The retractor muscles of the polypide are attached in one of the inferior angles of the zooecia. The opesium is irregularly subtrifoliate. The opesiular indentations serve for the passage of the parietal muscles. The onychocellarium is falciform with a single membranous expansion. A chitinous ring surrounds the end of the peculiar body; fourteen tentacles.

*Genotype.—Onychocella* (*Membranipora*) *angulosa* Reuss, 1847. *Range.—* Bathonian—Recent.

#### ONYCHOCELLA ANGULOSA Reuss, 1847.

Plate 32, figs. 31, 32.

1847. *Cellepora angulosa* REUSS, Die fossilen Polyparien des Weiner Tertiarbeckens, Haidinger's Naturwiss. Abhandlungen, vol. 2, p. 41, pl. 11, fig. 10.

1851. *Semieschara parisiensis* D'ORBIGNY, Paleontologie Francaise, Terrains Crétaces, p. 366.

1869. *Membranipora angulosa* REUSS, Studien Tertiarschichten Alpen, Denkschriften k. Akademie Wissenschaften, vol. 29, pp. 253, 262, 291, pl. 29, figs. 9–11.

1871. *Membranipora angulosa* MANZONI, Briozoi Pliocenici Italiani, Sitzungberichte k. Akademie Wissenschaften, vols. 59 and 60, pl. 2, fig. 10.

1874. *Membranipora angulosa* REUSS, Bryozoen Oesterreich-Ungarischen Miocäns, Denkschrift k. Akademie Wissenschaften, vol. 33, p. 185, pl. 10, figs. 13, 14.

1875. *Membranipora angulosa* MANZONI; I. Briozoi del Pliocene antico di Castrocaro, p. 8, pl. 1, fig. 11.

1891. *Onychocella angulosa* WATERS, North Italian Bryozoa, Quarterly Journal of the Geological Society, vol. 47, p. 9. (not synonymy).
1895. *Onychocella angulosa* NEVIANI, Bryozoi fossili Farnesina, Paleontographica Italica, vol. 1, p. 97, pl. 5, fig. 7.
1904. *Onychocella angulosa* CANU, Bryozoaires Tertiaires Tunisie, Explorations Scientifiques de la Tunisie, p. 18, pl. 34, fig. 2.
1907. *Onychocella angulosa* CANU, Bryozoaires des Terrains tertiaires des environs de Paris, Annales de Paleontologie, vol. 2, p. 21, pl. 3, fig. 11.
1908. *Onychocella angulosa* CANU, Bryozoaires fossiles des Terrains du Sud-Ouest de la France, Bulletin Société geologique de France, ser. 4, vol. 6, p. 513, pl. 12, fig. 13.
1909. *Onychocella angulosa* NORMAN, The Polyzoa of Madeira, Journal Linnean Society Zoology, vol. 30, p. 293, pl. 37, fig. 1.
1912. *Onychocella angulosa* CANU, Bryozoaires helvetiens de l'Egypte, Memoires de l'Institut egyptien, vol. 6, p. 201, pl. 10, fig. 10.

*Measurements.*—Opesia $\begin{cases} ho=0.16\text{–}0.20 \text{ mm.} \\ lo=0.18\text{–}0.20 \text{ mm.} \quad \text{(Max. 0.26.)} \end{cases}$

Zooecia $\begin{cases} Lz=0.40\text{–}0.60 \text{ mm.} \\ lz=0.40\text{–}0.60 \text{ mm.} \end{cases}$

Opesium of the onychocellarium $\begin{cases} hon=0.20 \text{ mm.} \\ lon=0.10 \text{ mm.} \end{cases}$ Onychocellarium $\begin{cases} Lon=0.60 \text{ mm.} \\ lon=0.28\text{–}0.30 \text{ mm.} \end{cases}$

*Affinities and variations.*—The zooecia are hexagonal, but of an irregularity which defies all constant micrometric measurements. The polypedian convexity is hardly apparent and the opesiular indentations are not symmetrical. The opesium is sometimes transverse, but more often somewhat elongated.

The opesium of the onychocellarium often has a small proximal sinus, larger in the interior than on the exterior as in the recent specimens.

The presence of this species off the Madeira Islands and in the Priabonian of Europe rendered it probable that it would be found in America. However, it is rare in the latter country.

*Occurrence.*—Middle Jacksonian: Wilmington, North Carolina (rare); near Lenuds Ferry, South Carolina (rare).

*Geological distribution.*—In France, this species makes its appearance in the Lutetian of the Paris Basin and the Pyrenean Basin (Canu). It exists abundantly in all the younger stages which border the Mediterranean in France, Italy, Algeria, Tunis, and Egypt.

*Habitat.*—Mediterranean (to a depth of 80 meters). Atlantic: Madeira Islands (50–70 fathoms). Pacific: Off China. The species seems to be an inhabitant of the warm seas.

*Plesiotypes.*—Cat. No. 63964, U.S.N.M.

### ONYCHOCELLA GEORGIANA, new species.

Plate 17, figs. 15, 16.

*Description.*—The zoarium incrusts rocks. The zooecia are hexagonal, elongated, distinct, but confluent among themselves. The cryptocyst is finely granular, concave, smaller than the opesium; the opesium is elliptical or oval with a convex proximal border. The onychocellarium is as large as the zooecia, falciform, acuminate, with an elliptical opesium.

*Measurements.*—Opesium of Onychocellaria $\begin{cases} \mathit{hon}=0.18\text{ mm.} \\ \mathit{lon}=0.10\text{ mm.} \end{cases}$ Onychocellarium $\begin{cases} \mathit{Lon}=0.40\text{ mm.} \\ \mathit{lon}=0.20\text{ mm.} \end{cases}$

Opesia of zooecia $\begin{cases} \mathit{ho}=0.20\text{–}0.24\text{ mm.} \\ \mathit{lo}=0.10\text{–}0.14\text{ mm.} \end{cases}$ Zooecia $\begin{cases} \mathit{Lz}=0.30\text{–}0.32\text{ mm.} \\ \mathit{lz}=0.20\text{–}0.24\text{ mm.} \end{cases}$

*Affinities and variations.*—This species is much smaller than *Onychocella angulosa* Reuss, 1867. Its polypidian convexity is scarcely apparent and disappears totally in the marginal zooecia where the opesium is then elliptical.

*Occurrence.*—Lower Jacksonian: Three and one-half miles southeast of Shell Bluff post office, Georgia (rare).

*Cotypes.*—Cat. No. 63862. U.S.N.M.

### ONYCHOCELLA CELSA, new species.

Plate 32, fig. 25.

*Description.*—The zoarium incrusts Cellepores. The zooecia are distinct, elongated, ogival, separated by a furrow or by a salient thread. The cryptocyst is deep, smooth, a little longer than the opesium; the opesium is placed *high*, ogival; the opesiular indentations are rather deep and nearly symmetrical. The onychocellarium is as large as a zooecium, lozenge-shaped, somewhat falciform; the opesium is large, elongated, median, oval, the point below.

*Measurements.*—Opesia of zooecia $\begin{cases} \mathit{ho}=0.15\text{ mm.} \\ \mathit{lo}=0.12\text{ mm.} \end{cases}$ Zooecia $\begin{cases} \mathit{Lz}=0.40\text{–}0.45\text{ mm.} \\ \mathit{lz}=0.35\text{–}0.40\text{ mm.} \end{cases}$

Opesia of onychocellaria $\begin{cases} \mathit{hon}=0.25\text{ mm.} \\ \mathit{lon}=0.10\text{ mm.} \end{cases}$ Onychocellaria $\begin{cases} \mathit{Lon}=0.45\text{–}0.50\text{ mm.} \\ \mathit{lon}=0.20\text{–}0.30\text{ mm.} \end{cases}$

*Affinities.*—This species differs from *Onychocella georgiana* in its salient polypidian convexity. It differs from *Onychocella angulosa* Reuss, 1845, in its smaller micrometric dimensions, its less falciform onychocellaria, and its more symmetrical and regular opesium. From *Onychocella laciniosa* it may be distinguished by its elongated and nontransverse opesium.

The only specimen found has been figured. It is a very beautiful example of this genus.

*Occurrence.*—Lower Jacksonian (Moodys marl): Jackson, Mississippi (rare).

*Holotype.*—Cat. No. 63958. U.S.N.M.

### ONYCHOCELLA LACINIOSA, new species.

Plates 32, figs. 26, 27.

*Description.*—The zoarium incrusts shells. The zooecia are hexagonal, confluent with one another by their mural rim. The cryptocyst is flat, smooth, depressed, longer than the opesium; the opesium is semilunar, transverse; the polypidian convexity is slightly projecting; the opesiular indentations are small and unsymmetrical. The onychocellarium is falciform, narrow, as long as the zooecium; its opesium is oval, narrowest below, contracted below the pivot. The ovicell is little apparent.

ORDINARY ZOOECIA.

| | | | |
|---|---|---|---|
| *Measurements.*—Opesia | $ho=0.08$ mm.<br>$lo=0.10$ mm. | Zooecia | $Lz=0.24–0.30$ mm.<br>$lz=0.20–0.30$ mm. |

ORDINARY ONYCHOCELLARIA.

| | | | |
|---|---|---|---|
| Opesia | $hon=0.10$ mm.<br>$lon=0.10$ mm. | Onychocellaria | $Lon=0.26$ mm.<br>$lon=0.14$ mm. |

MARGINAL ZOOECIA.

| | | | |
|---|---|---|---|
| Opesia | $ho=0.18–0.20$ mm.<br>$lo=0.16$ mm. | Zooecia | $Lz=0.40$ mm.<br>$lz=0.30–0.40$ mm. |

MARGINAL ONYCHOCELLARIA.

| | | | |
|---|---|---|---|
| Opesia | $hon=0.20$ mm.<br>$lon=0.08$ mm. | Onychocellaria | $Lon=0.46$ mm.<br>$lon=0.24$ mm. |

*Affinities and variations.*—In its external aspect this species is only a small *Onychocella angulosa;* but one important and very characteristic difference is the size of the marginal zooecia of the zoarium. We have expressed these micrometric variations numerically above.

Although small, the lateral *indentations* are very constant, even in the marginal zooecia. In this respect the species differs from *Onychocella georgiana.*

The ovarian zooecia have a somewhat larger opesium.

*Occurrence.*—Middle Jacksonian: Wilmington, North Carolina (rare); near Lenuds Ferry, South Carolina (rare); Rich Hill, 5¼ miles southeast of Knoxville, Georgia (rare).

Upper Jacksonian (Ocala limestone): Nine miles north of Ocala, Florida (rare); west bank of Sepulga River, Escambia County, Alabama (rare); Old Factory, 1½ miles above Bainbridge, Georgia (rare).

*Cotypes.*—Cat. Nos. 63959, 63960, U.S.N.M.

### ONYCHOCELLA DUPLICITER, new species.

Plate 32, figs. 28–30.

*Description.*—The zoarium incrusts other bryozoa. The zooecia are hexagonal, elongated, with their mural rims confluent, *dimorphous.* The cryptocyst is shallow and as long as the opesium; the opesium is oval, narrowest at the top; the polypidian convexity occurs only on the small zooecia *a;* the opesiular indentations are very small and nearly symmetrical. The onychocellarium is narrow, falciform, longer than the zooecia; its opesium is small, oval, narrowest below.

*Measurements.*—

| | Zooecia (*a*). | Zooecia B. | ONYCHOCELLARIA. |
|---|---|---|---|
| Opesia | $ho=0.08$ mm.<br>$lo=0.10–0.12$ mm. | $ho=0.14$ mm.<br>$lo=0.12$ mm. | $Lon=0.14$ mm.<br>$lon=0.06$ mm. |
| Zooecia | $Lz=0.36$ mm.<br>$lz=0.30$ mm. | $Lz=0.36–0.40$ mm.<br>$lz=0.28–0.32$ mm. | $Lon=0.50$ mm.<br>$lon=0.30$ mm. |

*Affinities and variations.*—In reality the zooecia are not dimorphous, for their micrometric dimensions are very similar; but there are actually two kinds of opesia. One is large, elongated, elliptical, with neither polypidian convexity, nor opesiular indentations; the other is small, transverse, with polypidian convexity and opesiular indentations (zooecia *a*). These two kinds of zooecia occur without apparent order, and we are in ignorance regarding the use of the large opesia.

*Occurrence.*—Middle Jacksonian: Wilmington, North Carolina (very rare); Rich Hill, Crawford County, Georgia (common); Eutaw Springs, South Carolina (common).

Upper Jacksonian (Ocala limestone): Along the west bank of Sepulga River, Escambia County, Alabama (very rare).

*Cotypes.*—Cat. Nos. 63961–63963, U.S.N.M.

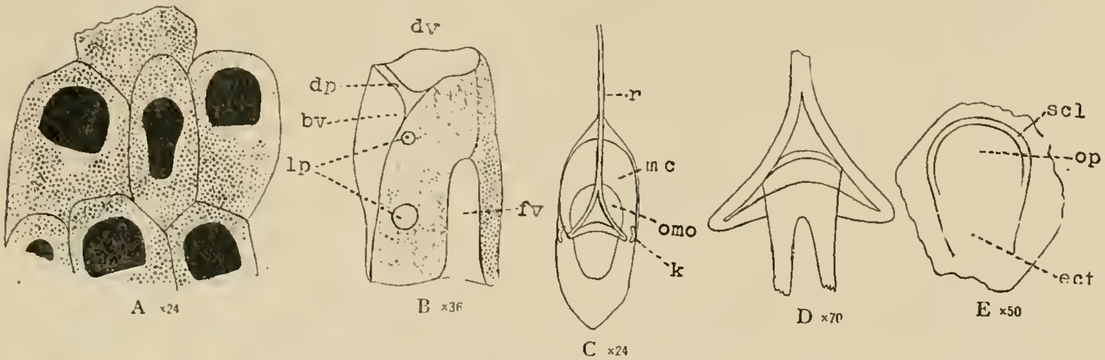


Fig 57.—Genus *Rectonychocella* Canu and Bassler, 1917.

A–E. *Rectonychocella solida* Nordgaard, 1907. A. Zooecia and onychocellarium, × 24. B. Longitudinal section of a zooecium, × 36. *bv*, basal wall; *dp*, distal dietella; *dv*, transversal wall; *fv*, frontal wall; *lp*, lateral septulae. C. Sketch showing mandible in place, × 24. *k*, lunate chitinous mass; *mc*, corneous membrane; *omo*, passage of occlusor muscles; *r*, rachis. D. Elevator muscles of the mandible, × 70. E. Opercular valve, × 50. (A–E after Norgaard, 1907.) *ect*, ectocyst; *op*, opercular valve; *scl*, sclerite.

### Genus RECTONYCHOCELLA Canu and Bassler, 1917.

1917. *Rectonychocella* Canu and Bassler, Synopsis of American Early Tertiary Cheilostome Bryozoa, Bulletin 96, United States National Museum, p. 25.

The retractor muscles of the polypide are attached in the median axis of the zooecia. The opesiular indentations are symmetrical. The onychocellaria are straight, and their opesium presents a posterior part, narrow and denticulated; the mandible is composed of two membranes. The zooecium is closed by an opercular valve. The mural rim is not separated from the cryptocyst.

*Genotype.*—*Onychocella solida* Nordgaard, 1907.

*Range.*—Jacksonian—Recent.

This genus differs from *Onychocella* only in the place of insertion of the retractor muscles of the polypide. This simple change causes a general symmetry of the zooecium and the onychocellarium.

The opesia are often without a polypidian convexity. They occur on zooecia provided with many bundles of parietal muscles as in the *Membraniporae.*

### RECTONYCHOCELLA BILAMELLARIA, new species.

Plate 33, figs. 1–3.

*Description.*—The zoarium is free and *bilamellar.* The zooecia are hexagonal, somewhat elongated, distinct or confluent through their mural rims. The cryptocyst is smooth, shallow, as long as the opesium; the opesium is oval, narrowest above; the polypidian convexity is small and inconstant; the opesiular indentations are symmetrical, small, and inconstant. The ovicell is endozooecial and is an indistinct distal convexity. The onychocellarium is straight, fusiform; its opesium is oval, the point below, with a contracted and very finely crenulated posterior part.

*Measurements.*—Opesium of zooecia $\begin{cases} ho=0.18\text{–}0.24 \text{ mm.} \\ lo=0.14\text{–}0.18 \text{ mm.} \end{cases}$

Opesium of onychocellaria $\begin{cases} hon=0.20 \text{ mm.} \\ lon=0.10 \text{ mm.} \end{cases}$

Zooecia $\begin{cases} Lz=0.48\text{–}0.50 \text{ mm.} \\ lz=0.36 \text{ mm.} \end{cases}$ Onychocellaria $\begin{cases} Lon=0.40\text{–}0.50 \text{ mm.} \\ lon=0.16\text{–}0.20 \text{ mm.} \end{cases}$

*Affinities and variations.*—The opesium is quite variable. The form with polypidian convexity is shorter and the rarer, while the oval form with the proximal border concave is the longer (=0.24 mm) and sometimes occurs solely over an entire zoarium. We have observed a calcified zooecium perforated by a circular orifice.

This species differs from *Rectonychocella semiluna* in its bilamellar zoarium and in the opesium of the onychocellarium which is shorter than the zooecial opesium. It is not dimorphous as in *Diplopholeos fusiforme.*

*Occurrence.*—Upper Jacksonian (Ocala limestone): west bank of Sepulga River, Escambia County, Alabama (common); Old Factory, 1½ miles above Bainbridge, Georgia (rare).

*Cotypes.*—Cat. No. 63966, U.S.N.M.

### RECTONYCHOCELLA SEMILUNA, new species.

Plate 33, figs. 9–13.

*Description.*—The zoarium is free, unilamellar, creeping over algae. The zooecia are slightly elongated, hexagonal, distinct, separated by a very small furrow. The cryptocyst is convex, smooth, shallow, a little shorter than the opesium; the opesium is elongated, oval, almost *semilunar*, entire; the polypidian convexity and the opesiular indentations are hardly visible. The ovicell is but little apparent. The onychocellarium is straight, rather large, fusiform; its opesium is oval, the pointed end below, always longer than the zooecial opesium, with a finely denticulated poster; the small distal canal rarely fuses with the distal zooecia (on which consequently the rachis of the mandible is laid). Two or three septulae to the zooecial wall.

*Measurements.*—Opesium of zooecia $\begin{cases} ho=0.20\text{–}0.24 \text{ mm.} \\ lo=0.16 \text{ mm.} \end{cases}$

Opesium of onychocellarium $hon$=0.34–0.36 mm.
$lon$=0.16 mm.

Zooecia $Lz$=0.40 mm.
$lz$=0.30 mm.

Onychocellaria $Lon$=0.50 mm.
$lon$=0.24–0.30 mm.

*Variations.*—The important character of this species is the large opesium of the onychocellaria which is always longer than the zooecial opesium. This greater size is above all very apparent in tangential sections (fig. 12) or in views of the interior (fig. 10). At the exterior the breadth of the opesium is reduced in the progress of calcification (fig. 11), but the length always remains quite evident. On the same zoarium (fig. 13) one may thus observe both wide and narrow opesia.

In the underside of the zoarium the zooecia are very irregularly convex; the olocyst is covered exteriorly by a thin calcareous pellicle. Finally, it is not rare to discover some zoaria incrusting other bryozoa.

Tangential thin sections (fig. 12) show that the olocyst constitutive of the zooecial walls is vacuolar. Such checks in calcification are not rare in old zoaria of the Onychocellidae.

*Affinities.*—This species differs from *Rectonychocella bilamellaria* in its unilamellar zoarium and in its large onychocellarian opesia.

It differs from *Diplopholeos fusiforme* in the absence of the zooecial dimorphism, in its unilamellar zoarium, and in its onychocellarium, which does not fuse with the distal zooecium. To differentiate it from this last species is often very difficult, and the inexperienced student ought to abstain from any determination which does not appear exact to him.

*Occurrence.*—Middle Jacksonian: Wilmington, North Carolina (common); Baldock, Barnwell County, South Carolina (rare); Rich Hill, Crawford County, Georgia (common); 18 miles west of Wrightsville, Johnson County, Georgia (rare); 3½ miles north of Grovania, Georgia (rare); Twiggs County, Georgia, one-half mile southeast of the Georgia Kaolin Co. Mine (very abundant).

Upper Jacksonian (Ocala limestone): Alachua, Florida (common).

*Cotypes.*—Cat. No. 63971, U.S.N.M.

### RECTONYCHOCELLA TENUIS, new species.

Plate 33, figs. 4–6.

*Description.*—The zoarium incrusts shells. The zooecia are elongated, with their mural rims confluent. The cryptocyst is very slightly developed, much shorter than the opesium, very thin laterally; the opesium is large, elongated, entire, oval, or elliptical. The onychocellarium is larger than the zooecium, fusiform; the distal canal is very small; the opesium of the onychocellarium is longer than the zooecial opesium, oval, the point at the top.

*Measurements.*—Opesium of zooecium $\begin{cases} ho=0.35\text{ mm.}\\ lo=0.25\text{ mm.}\end{cases}$

Zooecium $\begin{cases} Lz=0.45\text{–}0.55\text{ mm.}\\ lz=0.40\text{–}0.45\text{ mm.}\end{cases}$

Opesium of onychocellarium $\begin{cases} hon=0.45\text{ mm.}\\ lon=0.17\text{ mm.}\end{cases}$

Onychocellarium $\begin{cases} Lon=0.75\text{–}0.90\text{ mm.}\\ lon=0.30\text{ mm.}\end{cases}$

*Affinities.*—This fine species does not exhibit a polypidian convexity, which characteristic clearly distinguishes it from *Rectonychocella semiluna;* moreover, the point of the onychocellarian opesium is more often at the top than at the bottom. In the vicinity of the ancestrula the onychocellaria are much less in width than the zooecia (fig. 6).

*Occurrence.*—Lower Jacksonian (Moodys marl): Jackson, Mississippi (common).

Jacksonian (Zeuglodon zone): Cocoa Postoffice, Choctaw County, Alabama (rare); Shubuta, Mississippi (rare); Bluff on south side of Suck Creek, Clarke County, Mississippi (very rare).

Upper Jacksonian (Ocala limestone), west bank Sepulga River: Escambia County, Alabama (rare); Alachua, Florida (rare); nine miles north of Ocala, Florida (rare).

Vicksburgian (Red Bluff clay): Seven and one-half miles southwest of Bladen Springs, Alabama (rare).

*Cotypes.*—Cat. Nos. 63967, 63968, U.S.N.M.

### RECTONYCHOCELLA ELLIPTICA, new species.

Plate 33, figs. 7, 8.

*Description.*—The zoarium incrusts shells (Ostrea) or bryozoa. The zooecia are elongated, hexagonal, distinct, separated by a small furrow or thread. The cryptocyst is concave, deep, finely granulose, and as long as the opesium; the opesium is *elliptical*, elongated, finely crenulated; the polypidian convexity is only visible in the vicinity of the ancestrula. The endozooecial ovicell is a barely visible convexity. The onychocellarium is straight, lozenge-shaped, enlarged at the base; its cryptocyst is very small, and its opesium is oval, the point below, with a denticulated posterior; the small distal canal often fuses with the cryptocyst of the distal zooecium. The ancestrula is small and exhibits a polypidian convexity.

*Measurements.*—Opesia of zooecia $\begin{cases} ho=0.30\text{ mm.}\\ lo=0.20\text{ mm.}\end{cases}$ Zooecia $\begin{cases} Lz=0.40\text{–}0.50\text{ mm.}\\ lz=0.34\text{–}0.36\text{ mm.}\end{cases}$

Opesia of onychocellaria $\begin{cases} hon=0.34\text{–}0.36\text{ mm.}\\ lon=0.16\text{ mm.}\end{cases}$

Onychocellaria $\begin{cases} Lon=0.60\text{–}0.70\text{ mm.}\\ lon=0.24\text{ mm.}\end{cases}$

*Variations.*—The specimens from Jackson, Mississippi, have the zooecia very distinctly marked, because they are separated by a thin and salient thread, which gives them a particular aspect very difficult to define. In the other localities the zooecia are united among themselves and quite indistinct, giving these specimens a very different appearance. Nevertheless, the other characters are identical.

The onychocellarian opesium is a little longer than that of the zooecium, but the character is not evident at first glance because of its slight width.

The fusion of the distant canal of the onychocellarium with the cryptocyst of the distal zooecium is not general and the extreme point of this organ is often distinct without ever being prominent.

*Affinities.*—The difference between this species and *Rectonychocella bilamellaria* is almost entirely zoarial. Still, there are some slight zooecial differences; the opesium is elliptical, without an enlarged, straight or convex proximal border, and the length of the onychocellarian opesium is a little greater than the opesium of the zooecium.

The species differs from *Rectonychocella tenuis* in its smaller micrometric dimensions (Lz=0.45 mm. instead of 0.55 mm.) and in its onychocellarian opesium which is smaller and more tapering below.

*Occurrence.*—Upper Jacksonian (Ocala limestone): Bainbridge, Georgia (rare); Chipola River east of Marianna, Florida (rare); West Bank Sepulga River, Escambia County, Alabama (rare).

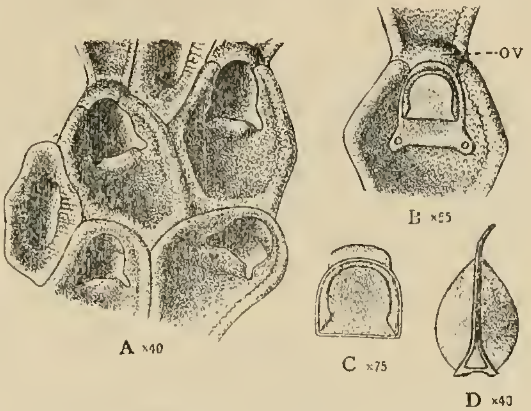


Fig. 58.—Genus *Velumella* Canu and Bassler, 1917.

A–D. *Velumella* (*Onychocella*) *levinseni* Canu and Bassler, 1917. A. A group of zooecia, the two uppermost with ovicell, × 40. B. A zooecium with ovicell(*ov*). In the covering membrane of the aperture is seen a simple chitinized operculum, and in each of the two sinuses of the aperture is the end of a parietal muscle, × 55. C. A zooecial operculum above which there is an ooecial operculum, × 75. D. Avicularian mandible, × 40.

*Cotypes.*—Cat. Nos. 63969, 63970, U.S.N.M.

### Genus VELUMELLA, Canu and Bassler, 1917.

1917. *Velumella* Canu and Bassler, Synopsis of American Early Tertiary Cheilostome Bryozoa, Bulletin 96, United States National Museum, p. 26.

The retractor muscles of the polypide are attached in the median axis of the zooecium; the opesiular indentations are symmetrical. The onychocellaria are straight, without distal canal; the rachis of the mandible bears two broad membranes; the opesium of the onychocellarium is elliptical and entirely denticulated.

The operculum is a wholly chitinized simple one, not separable from the ectocyst. Multiporous septulae. The mural rim is distinct from the cryptocyst.

*Genotype.*—*Velumella* (*Onychocella*) *levinseni* Canu and Bassler, 1917.[1]

The mural rim and the cryptocyst are formed from the same olocystal elements; they are not distinct from each other, and their separation is purely superficial. The operculum is revealed by the two small lateral teeth of the opesium which indicates its axis of rotation. The small size of the opesiular indentations is indicative of very small parietal muscles.

### VELUMELLA LEVIGATA, new species.

Plate 34, figs. 1–3.

*Description.*—The zoarium incrusts rocks. The zooecia are hexagonal, regular, with their mural rim confluent. The cryptocyst is deep, flat, *smooth;* the mural rim is thick, convex; the opesium is semilunar, transverse; the polypidian convexity is little apparent; the opesiular openings are small and round. The onychocellarium is hexagonal like the zooecium; its opesium is large, elongated, irregular, oval or elliptical.

*Measurements.*—Opesium $\left\{\begin{array}{l} ho=0.07\text{–}0.10\text{ mm.}\\ lo=0.10\text{–}0.12\text{ mm.}\end{array}\right.$ Zooecium $\left\{\begin{array}{l} Lz=0.35\text{ mm.}\\ lz=0.32\text{ mm.}\end{array}\right.$

Opesium of onychocellarium $\left\{\begin{array}{l} hon=0.22\text{–}0.30\text{ mm.}\\ lopn=0.10\text{ mm.}\end{array}\right.$

*Affinities.*—This species differs from *Velumella plicata* in its transverse opesium, its smooth cryptocyst, and its round opesiular openings.

*Occurrence.*—Upper Jacksonian (Ocala limestone): Alachua, Florida (rare); 9 miles north of Ocala, Florida (rare); West bank of Sepulga River, Escambia County, Alabama (rare).

*Cotypes.*—Cat. Nos. 63972–63974, U.S.N.M.

### VELUMELLA PLICATA, new species.

Plate 34, fig. 4.

*Description.*—The zoarium forms broad incrustations on shells. The zooecia are hexagonal, elongated, their mural rims confluent. The cryptocyst is deep, flat, finely granulated; the polypidian convexity is salient and longitudinally *wrinkled;* the opesium is semilunar, crenulated, elongated; the opesiular openings are small, oblique, linear. The onychocellarium is larger than the zooecium; its opesium is large, median and oval.

*Measurements.*—Opesium $\left\{\begin{array}{l} ho=0.10\text{–}0.12\text{ mm.}\\ lo=0.08\text{–}0.10\text{ mm.}\end{array}\right.$ Zooecium $\left\{\begin{array}{l} Lz=0.40\text{ mm.}\\ lz=0.30\text{ mm.}\end{array}\right.$

Opesium of onychocellarium $\left\{\begin{array}{l} hon=0.25\text{–}0.30\text{ mm.}\\ lopn=0.18\text{–}0.20\text{ mm.}\end{array}\right.$

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[1] This new name was proposed for the recent species figured as *Onychocella* species by Levinsen in his Morphological and Systematic Studies on the Cheilostomatous Bryozoa, 1909, pl. 22, figs. 3*a–d*.

*Affinities.*—This species differs from *Velumella plicata* in its wrinkled polypidian convexity, in its non transverse opesium, and its linear opesiules. We have observed a normal zooecium replaced by a perforated calcified zooecium.

*Occurrence.*—Upper Jacksonian (Ocala limestone): along Chipola River, east of Marianna, Florida (very rare).

*Holotype.*—Cat. No. 63975, U.S.N.M.

### Genus DIPLOPHOLEOS Canu and Bassler, 1917.

1917. *Diplopholeos* CANU and BASSLER, Synopsis of American Early Tertiary Cheilostome Bryozoa, Bulletin 96, United States National Museum, p. 26.

The retractor muscles of the polypide are attached in the median axis of the zooecium. The lateral indentations are symmetrical and almost transformed into true opesiules. The onychocellaria are straight, their opesium is oval, with a denticulated poster; the mandible is bimembranous. The mural rim is not separated from the cryptocyst. The zooecium is closed by an operculum attached to the ectocyst. The axis of rotation of the operculum is indicated by two opesial denticles. The zooecial opesia are dimorphous; one kind is elongated and the other transverse.

*Genotype.*—*Diplopholeos fusiforme* Canu and Bassler, 1917.

*Range.*—Jacksonian, Vicksburgian.

This genus differs from *Rectonychocella* in its dimorphous opesia and its polypidian convexity, which is constant, protruding, and accompanied by two nearly complete opesiules. We are ignorant of the reason for the opesial dimorphism often accompanying zooecial dimorphism.

### DIPLOPHOLEOS FUSIFORME Canu and Bassler, 1917.

Plate 34, figs. 11-14.

1917. *Diplopholeos fusiforme* CANU and BASSLER, Synopsis of American Early Tertiary Cheilostome Bryozoa, Bulletin 96, United States National Museum, p. 26, pl. 3, fig. 2.

The zoarium incrusts shells and pebbles. The zooecia are hexagonal, a little elongated, separated by a narrow furrow or united among themselves by their mural rims; the cryptocyst is deep, concave, shorter than the opesium, finely granular; the polypidian convexity is protruding, wrinkled or granulated, denticulated on its opesial border; the lateral openings are deep, round, almost becoming true opesiules; the opesium is elongated, semilunate, finely crenulated. The ovicell is an inconspicuous distal convexity, sometimes limited by two lines of lateral suture. The onychocellarium is narrow, *fusiform*, somewhat larger than the zooecia; the opesium is median, oval, the point below, with a narrow and denticulated posterior; the terminal point projects above the distal zooecium, but is very fragile; the distal canal through alteration in fossilization fuses nearly always with the cryptocyst of the distal zooecium. The heteromorphic zooecia are a little smaller; their cryptocyst is longer than the opesium which then appears nearly transverse. The ancestrula is of the same form as the zooecium.

*Measurements.*—Opesium of zooecia $ho=0.20$ mm. (measuring only to the polypidian convexity)
$lo=0.15$ mm. (without the opesiules)
Zooecium $Lz=0.40$ mm.
$lz=0.30$ mm.
Opesium of onychocellaria $hon=0.20$ mm.
$lopn=0.10$ mm.
Onychocellaria $Lon=0.40$–$0.45$ mm.
$lon=0.20$ mm.

*Variations.*—The zooecia with the small opesium (*a*) are not regularly smaller than the others; we can not therefore employ the nomenclature used by Harmer for the Steganoporellidae. The reduction of the opesium is due to the enlargement of the cryptocyst; we must therefore suppose that the parietal muscles are inserted there higher in consequence of the development of an organ of which we know nothing. This organ can be neither the ovary nor the testicles, for we have observed ovicells in both forms of zooecia.

The fusion of the small distal canal of the fusiform onychocellarium with the cryptocyst of the distal zooecia is so general that we may now consider its character as distinctive upon first examination. The marginal zooecia are unprovided with polypidian convexity and lateral opesiules.

The zoarium sometimes creeps over algae. The unilamellar specimens often arise primarily from incrusting specimens which are detached from their substratum.

The mural rim and the cryptocyst are formed of the same elements secreted by the endocyst. These elements are grouped in radiating series around the opesium (fig. 14).

*Affinities.*—This species differs from *Diplopholeos sagittellarium* and from *D. sagittarium* by the form of its onychocellarium, by the fusion of the distal canal with the cryptocyst of the distal zooecium, and by its larger zooecial dimensions.

When the zooecial dimorphism is not apparent, this species much resembles *Rectonychocella semiluna;* but it is distinguished from it by its incrusting zoarium and its very distinct, nearly complete opesiules.

*Occurrence.*—Middle Jacksonian (Castle Hayne limestone): Wilmington, North Carolina (common).

Upper Jacksonian (Ocala limestone): Old Factory, 1½ miles above Bainbridge, Georgia (common); Bainbridge, Georgia (very rare); 4 miles below Bainbridge, Georgia (common); 7 miles above Bainbridge, Georgia (common); West bank of Sepulga River, Escambia County, Alabama (common); Chipola River, east of Marianna, Florida (common); 9 miles north of Ocala, Florida (common): Plant System Railroad wharf at Bainbridge, Georgia (rare).

*Cotypes.*—Cat. Nos. 63979, 62582, U.S.N.M.

### DIPLOPHOLEOS SAGITTELLARIUM, new species.

Plate 34, figs. 5–7.

*Description.*—The zoarium incrusts shells and bryozoa. The zooecia are hexagonal, indistinct, with their mural rims confluent; the cryptocyst is shallow, oblique toward the opesium, very finely granulated, longer than the opesium; the polypidian convexity projects but little, occurs below the opesial denticles, and is elevated almost vertically; the opesiular openings are large, round; the opesium is transverse in appearance (with the opesial openings), semilunar, narrowed anteriorly by two lateral teeth above the opesiules. The ovicell is an inconspicuous distal convexity. The onychocellarium is straight, much larger than the zooecium, with the form of a small leaf of the plant *Sagittaria*, terminated by a large mandibular area; its opesium is oval, the point at the top, entire or crenulated. Dimorphism is manifested by large and small zooecia.

| | |
|---|---|
| *Measurements.*—Opesium of small zooecium ($a$) including opesiules | $ho=0.08$ mm.<br>$lo=0.10$–$0.12$ mm. |
| Small zooecium ($a$) | $Lz=0.40$ mm<br>$lz=0.34$ mm. |
| Opesium of large zooecium ($B$) including opesiules | $ho=0.16$ mm.<br>$lo=0.10$–$0.12$ mm. |
| Large zooecium ($B$) | $Lz=0.50$ mm.<br>$lz=0.34$ mm. |
| Opesium of onychocellarium | $hon=0.20$ mm.<br>$lopn=0.12$ mm. |
| Onychocellarium | $Lon=0.70$ mm.<br>$lon=0.30$ mm. |

*Variations.*—The large zooecia occur less frequently. Well preserved specimens have the aspect of *Steganoporella;* but if the specimen is turned and the interior is examined, the internal divisions characteristic of *Steganoporella*, limiting the polypidan tube, can not be seen (fig. 7).

Good specimens also show that the polypidian convexity is elevated almost vertically as in *Thalamoporella*, and when the opesial denticles are united with the convexity, such examples have then a constitution identical with that of this genus. The ovicells however are very different (fig. 5).

Most often the polypidian convexity is broken or not developed, but the opesiular openings are always quite distinct (fig. 5).

The zooecial dimorphism has to do perhaps with a double system of nutrition.

*Affinities.*—Its zooecial dimorphism and the form of its onychocellarium clearly characterize this beautiful species. It differs from *Diplopholeos sagittarium* in the smaller dimensions of its onychocellarium and in the absence of opesial denticles in this organ.

*Occurrence.*—Middle Jacksonian: Wilmington, North Carolina (common); Near Lenuds Ferry, South Carolina (rare).

Upper Jacksonian (Ocala limestone): Old Factory, 1½ miles above Bainbridge, Georgia (rare).

*Cotypes.*—Cat. No. 63976, U.S.N.M.

### DIPLOPHOLEOS SAGITTARIUM, new species.

Plate 34, fig. 8.

*Description.*—The zoarium is incrusting. The zooecia are elongate, indistinct, confluent through their mural rims. The cryptocyst is very shallow, oblique toward the opesium, finely granular, much longer than the opesium; the polypidian convexity is elevated to the level of the opesial denticles; the opesiular openings are large, round, deep, and are almost true opesiules; the opesium is semilunar, narrowed below by two very prominent denticles bounding the upper part of the two opesiules. The onychocellarium is very large, having the form of a leaf of *Sagittaria;* the distal submandibular area is much developed. The opesium is oval, the point at the top with two long denticles inserted on the proximal margin. The ovicell is an indistinct, distal convexity.

*Measurements.*—Onychocellarium $\begin{cases} Lon=0.70\text{–}0.80\text{–}0.90 \text{ mm.} \\ lon=0.24 \text{ mm.} \end{cases}$

*Affinities.*—This species differs from *Diplopholeos sagittellarium* in the size of its onychocellaria and in the two opesial denticles of this organ.

*Occurrence.*—Middle Jacksonian: Wilmington, North Carolina (common); Rich Hill, Crawford County, Georgia (common).

*Holotype.*—Cat. No. 63977, U.S.N.M.

### DIPLOPHOLEOS PARVULIPORUM, new species.

Plate 34, figs. 9, 10.

*Description.*—The zoarium incrusts bryozoa. The zooecia are small, elongated, ogival, distinct, or confluent through their mural rims. The cryptocyst is shallow, oblique to the opesium; the polypidian convexity is elevated to the level of two very prominent denticles; the opesiules bounded by the polypidian convexity and by the denticles are almost complete. The ovicell is endozooecial and is a large distal convexity. The onychocellarium is larger than the zooecium; its opesium is elliptical, sometimes denticulated below, its submandibular area distally is very large and presents the form of a leaf of *Sagittaria.*

*Measurements.*—Opesium of zooecium $\begin{cases} ho=0.06 \text{ mm.} \\ lo=0.08 \text{ mm.} \end{cases}$ Zooecium $\begin{cases} Lz=0.32\text{–}0.36 \text{ mm.} \\ lz=0.24 \text{ mm.} \end{cases}$

Opesium of onychocellarium $\begin{cases} hon=0.17 \text{ mm.} \\ lopn=0.08\text{–}0.10 \text{ mm.} \end{cases}$ Onychocellarium $\begin{cases} Lon=0.52 \text{ mm.} \\ lon=0.17 \text{ mm.} \end{cases}$

*Affinities.*—This species is very close to *Diplopholeos sagittellarium* and differs from it solely in its *small dimensions.* The dimorphism is little apparent on our specimens.

*Occurrence.*—Middle Jacksonian (Castle Hayne limestone): Wilmington, North Carolina (rare).

*Cotypes.*—Cat. No. 63978, U.S.N.M.

### DIPLOPHOLEOS LINEATUM, new species.

Plate 82, fig. 15.

*Description.*—The zoarium incrusts shells. The zooecia are hexagonal, elongated, confluent by means of their mural rims. The cryptocyst is deep, granular, longer than the opesium; the polypidian convexity is projecting, crenulated along its opesial border; the opesiular indentations are deep, sometimes *linear;* the opesium is elongated, semielliptical, narrowed above the opesiules by two prominent denticles. The onychocellarium is small, fusiform, without distal canal; its opesium is median, elliptical, crenulated.

*Measurements.*—Opesium $\left\{\begin{array}{l} ho=0.20 \text{ mm.} \\ lo=0.12 \text{ mm.} \end{array}\right.$ Zooecium $\left\{\begin{array}{l} Lz=0.44 \text{ mm.} \\ lz=0.40\text{–}0.50 \text{ mm.} \end{array}\right.$

Onychocellarium $\left\{\begin{array}{l} Lon=0.35 \text{ mm.} \\ lon=0.25 \text{ mm.} \end{array}\right.$

The long linear opesia are rather rare; there are some perfectly round. The opesial dimorphism is not apparent on the few specimens we possess and we classify the species only by analogy.

*Affinities.*—This species differs from *Diplopholeos fusiforme* in its small onychocellarium and its linear opesiules.

The opesial dimorphism is not very evident on the specimens found.

*Occurrence.*—Vicksburgian (Marianna limestone): Near Claiborne. Monroe County, Alabama (very rare); Salt Mountain, 5 miles south of Jackson, Alabama (very rare).

Vicksburgian (Byram marl): Byram. Mississippi (rare).

*Holotype.*—Cat. No. 64252, U.S.N.M.

### Genus FLORIDINA Jullien, 1881.

1881. *Floridina* JULLIEN, Note sur une nouvelle division des Bryozoaires Cheilostomes, Bulletin Societe Zoologique France, vol. 6, p. 13.

The retractor muscles of the polypide are attached in the median axis of the zooecium. The opesiular indentations are symmetrical, very large, limited above by the two very salient opesial processes and placed on each side of a much produced. semitubular, polypidian convexity. The zooecium is closed by an operculum attached to the ectocyst; the opercular axis of rotation is located above the two opesial processes. The onychocellaria are straight, without the small, distal canal, rounded at their apex; the mandible is bimembranous. Ovicell endozooecial.

The general aspect of the opesium is trifoliate.

*Genotype.*—*Floridina* (*Mollia*) *antiqua* Smitt, 1872.

*Range.*—Senonian-Recent.

Species of *Floridina* for the most part are found incrusting algae.

The opesiular indentations serve as a passageway for both the parietal and opercular muscles. Exteriorly the polypidian convexity quite resembles the polypide tube of *Steganoporella;* but in the interior it is incomplete (pl. 35, fig. 16), and it is rare even that the tuberosities ($t$) bound it laterally.

Irregularity is the rule in this genus; all the characters of the opesium are extraordinarily variable. Determination of the species is often difficult and causes much perplexity for the naturalist.

The opesial processes often join the polypidian convexity, the opesiules thus becoming complete; in the interior the aspect is identical with that of *Thalamoporella.*

The known species of this genus are:

*Floridina* (*Semieschara*) *canui* Brydone, 1900.
*Floridina* (*Cellepora*) *crustulenta* Goldfuss, 1828.
*Floridina* (*Semieschara*) *bimarginata* D'Orbigny, 1852.
*Floridina* (*Mollia*) *antiqua* Smitt, 1873.
*Floridina vendoma* Canu, 1900.

There has as yet been no evidence of the genus in the American Cretaceous. If this observation be confirmed we will be obliged to repeat that the beginning of the Eocene is the time when the change in direction of the Atlantic currents occurred.

### FLORIDINA GRANULOSA, new species.

Plate 35, figs. 1–4.

*Description.*—The zoarium is bilamellar with distorted fronds. The zooecia are distinct, hexagonal, separated by a deep furrow. The mural rim and cryptocyst are covered with *granulations* more or less large. The opesium is large, a little elongated, trifoliate; the opesiular portion is large, orbicular and separated from the opercular portion by two salient teeth. The ovicell is endozooecial; this is a distal convexity little apparent. The onychocellarium is elongated, elliptical, as large as the zooecium; the opesium is oval, the point above and bears laterally two salient denticles.

| | | | |
|---|---|---|---|
| *Measurements.*—Opesium of zooecia | $ho=0.22$ mm.<br>$lo=0.15$ mm. | Zooecia | $Lz=0.45$–$0.50$ mm.<br>$lz=0.35$–$0.40$ mm. |
| Opesium of onychocellaria | $hon=0.25$ mm.<br>$lon=0.15$ mm. | Onychocellarium | $Lon=0.45$–$0.50$ mm.<br>$lon=0.35$–$0.40$ mm. |

*Variations and affinities.*—The ovicelled zooecia have an opesium and larger micrometric dimensions (fig. 1). We have observed some calcified zooecia (fig. 2) bearing a large central perforation.

This species is very well characterized by the absence (not constant) of the polypidian convexity and by its frontal granulations.

*Occurrence.*—Lower Jacksonian (Moodys marl): Jackson, Mississippi (rare).

*Cotypes.*—Cat. No. 63980, U.S.N.M.

### FLORIDINA BIFOLIATA, new species.

Plate 35, fig. 5.

*Description.*—The zoarium is *bilamellar* with curved fronds. The zooecia are distinct, quite elongated, separated by a deep furrow; the mural rim is smooth, wide, little salient; the cryptocyst is of little depth, of the same length as the opesium. The opesium is large, trifoliate, elongate; the opercular portion is small and separated from the opesiular region by two, little prominent teeth; the polypidian convexity is little salient, non symmetrical. The onychocellarium is larger than the zooecia, quite elongated, fusiform, with spatulate beak; the opesium is oval, the point above.

*Measurements.*—Opesium of zooecia $\begin{cases} ho=0.25 \text{ mm.} \\ lo=0.20\text{–}0.22 \text{ mm.} \end{cases}$ Zooecium $\begin{cases} Lz=0.50\text{–}0.52 \text{ mm.} \\ lz=0.35\text{–}0.40 \text{ mm.} \end{cases}$

Opesium of onychocellaria $\begin{cases} hon=0.40 \text{ mm.} \\ lon=0.11 \text{ mm.} \end{cases}$ Onychocellarium $\begin{cases} Lon=0.80 \text{ mm.} \\ lon=0.30 \text{ mm.} \end{cases}$

*Affinities.*—This species has a bilamellar zoarium like *Floridina granulosa;* it differs from it in the absolutely smooth frontal, and its onychocellarium much longer than the zooecia.

*Occurrence.*—Lower Jacksonian (Moodys marl): Jackson, Mississippi (rare).

*Holotype.*—Cat. No. 63981, U.S.N.M.

### FLORIDINA ONYDENTATA, new species.

Plate 35, fig. 9.

*Description.*—The zoarium is unilamellar, creeping over algae. The zooecia are distinct, wide, ogival; the cryptocyst is shallow, concave, oblique to the opesium, finely granulated; the opesium is transverse or trifoliate. The opesiules are nearly complete and linear. The polypidian convexity is very long and often united with the opesial processes. The onychocellarium is larger than the zooecium; its opesium is triangular and *toothed*, with a large spine on its proximal border.

*Measurements.*—Opesium (including opesiules) $\begin{cases} ho=0.14\text{–}0.20 \text{ mm.} \\ lo=0.20\text{–}0.24 \text{ mm.} \end{cases}$ Zooecium $\begin{cases} Lz=0.50\text{–}0.60 \text{ mm.} \\ lz=0.30\text{–}0.40 \text{ mm.} \end{cases}$

Onychocellarium $\begin{cases} Lon=0.90 \text{ mm.} \\ lon=0.50 \text{ mm.} \end{cases}$

*Variations.*—It is probable, that the pivot of the mandible was situated a little above the opesial tooth; this indicates that there were on each side two bundles of mandibular elevator muscles.

The size of the opesiules is evidence of vigorous parietal muscles, necessary, moreover, for the zoarial hydrostatic system of this robust species.

We have observed a true zooecium having the form of an onychocellarium. More than once it has been proved that this organ is only a modified zooecium, and that every variation of one occasions a corresponding variation in the other.

*Affinities.*—This is the largest known species of *Floridina.* This character and the large teeth in the opesium of its onychocellarium distinguish it clearly from *Floridina antiqua* and from *F. laguncula.*

*Occurrence.*—Middle Jacksonian (Castle Hayne limestone): Wilmington, North Carolina (common).

*Holotype.*—Cat. No. 63983, U.S.N.M.

### FLORIDINA ANTIQUA Smitt, 1873.

Plate 35, figs. 10–18.

1873. *Mollia antiqua* Smitt, Floridan Bryozoa, Kongl. Svenska Vetenskaps-Akademie Handlingar, vol. 3, p. 12, pl. 2, fig. 73 (not Busk).

*Description.*—The zoarium is unilamellar, creeping over algae. The zooecia are broad, distinct, ogival in shape; the cryptocyst is a little concave and very finely granulated; the polypidian convexity is a continuation of the cryptocyst; the opesium is subtrifoliate and contracted by two large lateral teeth which separate the opercular part from the opesiular portion. The opesiular indentations are large and wide; they are often transformed into true, nearly complete linear opesiules by the union of the opesial process with the polypidian convexity. The ovicell is a distal convexity little apparent, but clearly distinct from the cryptocyst of the distal zooecium. The onychocellarium is larger than the zooecium, elongated, with a submandibular area rounded but little developed; its opesium is oval, the pointed end at the top, much denticulated.

*Measurements.*—Opesium (including opesiules) $\begin{cases} ho=0.20\text{–}0.24 \text{ mm.} \\ lo=0.20\text{–}0.24 \text{ mm.} \end{cases}$ Zooecium $\begin{cases} Lz=0.50 \text{ mm.} \\ lz=0.40 \text{ mm.} \end{cases}$

Onychocellarium $\begin{cases} Lon=0.60 \text{ mm.} \\ lon=0.30 \text{ mm.} \end{cases}$

*Variations.*—Interzooecial communication appears to be effected by a distal septula and 4 pairs of lateral septulae (fig. 18). The cryptocyst is as usual, formed from elements of the olocyst (fig. 18).

In the interior (fig. 16), the form of the opesium is the same; we note further that there are two tuberosities roughly outlining laterally a polypide tube. The proximal margin of the opesium of the onychocellarium is thickened.

The union of the opesial processes with a polypidian convexity is frequent (fig. 18). On the more perfect specimens the length of the polypidian convexity is from 0.06 to 0.08 mm.; its width is from 0.14–0.16 mm. (fig. 11). It often diminishes in length without apparent reason and even disappears (fig. 12).

The size and aspect of the zooecia vary greatly. Figures 13, 14, 15 are taken from the same zoarium, where there may be noted broad zooecia with a reduced cryptocyst, smaller zooecia with the cryptocyst much developed, and again very narrow zooecia. Usually most of the zooecia are broad, and most of the opesiules are large and incomplete.

The zoarium sometimes incrusts shells; the polypidian convexity is then little apparent, and the opesiules are quite large.

*Affinities.*—This species differs from *Floridina laguncula* in its larger micrometric dimensions ($Lz$=0.50 mm. and not 0.40 mm), in its nearly always trifoliate opesium, and in its large and rounded opesiular openings. It is smaller than *Floridina onydentata.*

*Occurrence.*—Middle Jacksonian: Wilmington, North Carolina (common); near Lenuds Ferry, South Carolina (common); Baldock, Barnwell County, South Carolina (common); 3¼ miles south of Perry, Georgia (rare); 3½ miles north of Grovania, Georgia (rare); 1½ miles northeast of Lily, Dooly County, Georgia (rare).

Upper Jacksonian (Ocala limestone): Bainbridge, Georgia (rare); 1½ miles above Bainbridge, Georgia (rare).

Vicksburgian (Marianna limestone): Salt Mountain, 5 miles south of Jackson, Alabama.

Vicksburgian (Byram marl): Byram, Mississippi (rare).

*Habitat.*—Smitt's original specimens were obtained in the waters of Florida, where the species ranges in depth from 29 to 44 fathoms.

*Plesiotypes.*—Cat. No. 63984, U.S.N.M.

### FLORIDINA LAGUNCULA, new species.

Plate 36, figs. 1–6.

*Description.*—The zoarium is free, unilamellar, creeping over algae, or incrusting stones, shells, or bryozoa. The zooecia are a little elongated, distinct, confluent through their mural rims; the cryptocyst is shallow, oblique, directed toward the opesium, very finely granular; the mural rim is projecting in front, convex, separated from the cryptocyst. The opesium is limited to the elliptical, transverse opercular portion; the two opesial processes are quite salient and are situated above the polypidian convexity, which is thus little apparent. The onychocellarium is elliptical, elongated, larger than a zooecium; its opesium is oval, divided into two parts, a lower one large and nearly round, and a distal one narrow and linear.

*Measurements.*—Opesium (including opesiules) $\begin{cases} ho=0.10\text{–}0.12 \text{ mm.} \\ lo=0.20 \text{ mm.} \end{cases}$ Zooecium $\begin{cases} Lz=0.40 \text{ mm.} \\ lz=0.30\text{–}0.35 \text{ mm.} \end{cases}$

Onychocellarium $\begin{cases} Lon=0.55 \text{ mm.} \\ lon=0.33 \text{ mm.} \end{cases}$

*Variations.*—In tangential sections the zooecial walls appear very thin (fig. 5). In the interior, the opesium is trifoliate or has the aspect of *Thalamoporella* or of *Steganoporella* (fig. 6). On the lower face of the zoarium, the zooecia are elongated, hexagonal, convex, and bear a projecting hydrostatic tuberosity (fig. 3).

The opesiules placed between the polypidian convexity and the opesial processes are hardly visible because they are thus perpendicular to the zooecial plane. But with the reduction of the processes they become visible in the form of rounded lateral openings (fig. 4).

In some specimens from the Vicksburgian the proximal border of the onychocellarian opesium is straight and the opesium itself is oval.

In its most usual aspect and when altered by fossilization, the opesium of the onychocellarium resembles a *small bottle*, whence our specific name.

*Affinities.*—*Floridina laguncula* differs from *F. antiqua* Smitt, 1873, in its smaller micrometric measurements (*Lz* 0.40 mm.), in its more apparent mural rims, in its smaller opesiules rarely visible exteriorly, and in its opesium which is reduced to the opercular region.

It differs from *Floridina asymmetrica* in the bottle shaped opesium of the onychocellarium, in its more elongated, regular zooecia, and in the symmetry of its opesium.

*Occurrence.*—Middle Jacksonian (Castle Hayne limestone): Wilmington, North Carolina (very common).

*Cotypes.*—Cat. No. 63985, U.S.N.M.

### FLORIDINA ASYMMETRICA, new species.

Plate 35, figs. 6–8.

*Description.*—The zoarium is unilamellar, tubular, growing over algae or incrusting their radicles. The zooecia are broad, distinct, hexagonal, somewhat ogival in shape; the cryptocyst is shallow, a little larger than the opesium, granular, without mural rim; the opesium is trifoliate and divided by two salient processes serving as upper limits to two incomplete and *unsymmetrical* opesiules; the polypidian convexity is deep, not prominent, and unsymmetrical. The onychocellarium is larger than the zooecium, pentagonal, very elongated; its opesium is triangular, denticulated.

*Measurements.*—Opesium (including opesiules) $\begin{cases} ho=0.20 \text{ mm.} \\ lo=0.16\text{–}0.20 \text{ mm.} \end{cases}$ Zooecium $\begin{cases} Lz=0.36\text{–}0.40 \text{ mm.} \\ lz=0.36\text{–}0.40 \text{ mm.} \end{cases}$

Onychocellarium $\begin{cases} Lon=0.50 \text{ mm.} \\ lon=0.25 \text{ mm.} \end{cases}$

*Variations.*—We have stated that irregularity is the rule in this genus. The symmetry of the zooecia is not absolute; on nearly all the zoaria there are asymmetrical zooecia. In this species the phenomenon is more general and symmetrical zooecia are rarer. The opesiular indentations and the polypidian convexity also lack symmetry, following the obliquity of the polypide in its lodging place occasioned by the eccentric attachment of the retractor muscles.

*Affinities.*—This species differs from *Floridina laguncula* in the absence of mural rim and in its irregular, although more visible, opesiules.

It differs from *Floridina antiqua* Smitt in its smaller micrometric measurements ($Lz=0.40$ mm), its less developed opesiules, and in its irregular and less visible polypidian convexity.

*Occurrence.*—Upper Jacksonian (Ocala limestone): Bainbridge, Georgia (rare); Old Factory, 1½ miles above Bainbridge, Georgia (rare).

*Cotypes.*—Cat. No. 63982, U.S.N.M.

### Genus SMITTIPORA Jullien, 1881.

1881. *Smittipora* JULLIEN, Note sur une nouvelle division des Bryozoaires Cheilostomes, Bulletin Société Zoologique de France, vol. 6, p. 14.

The cryptocyst which is deep and concave, exhibits three facets of which the two lateral ones are formed by the mural rim; the two lateral furrows which separate the mural rim from the cryptocyst are constant. The mandible of the onychocellarium is bimembranous; the onychocellarium and its opesium are little different from the zooecia.

*Genotype.*—*Smittipora* (*Vincularia*) *abyssicola* Smitt, 1873.

*Range.*—Senonian—Recent.

*Historical.*—It is not certain that the European Cretaceous species classified by Jullien in this genus really belong to the group of *Vincularia abyssicola* Smitt. To the best of our knowledge the ovicells have never been observed on the fossil forms, and Smitt's species has not yet been rediscovered. We have been unable to make any new observations on the specimens studied from the Midwayan which are of the type observed in the European Cretaceous. We are therefore obliged to follow Jullien's classification as Canu did in 1900.[1]

Neither Gabb and Horn in 1862 nor Ulrich and Bassler in 1907 have intimated the existence of *Smittipora* in the American Cretaceous. If this be confirmed, it will be necessary to admit that at the beginning of the Eocene a change occurred in the direction of the Atlantic marine currents.

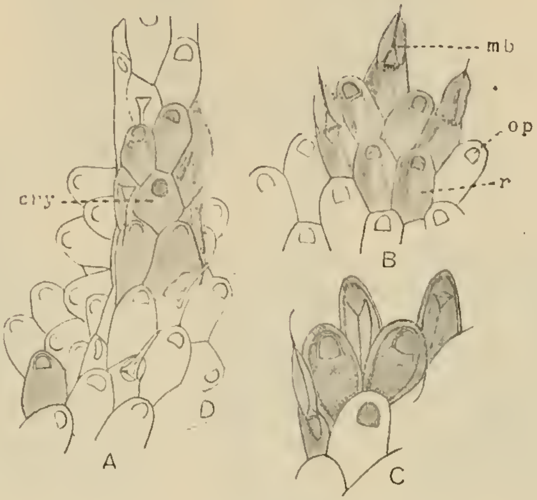

FIG. 59.—Genus *Smittipora* Jullien, 1881.

A–C. *Smittipora* (*Vincularia*) *abyssicola* Smitt, 1872. A. Zoarium in the vincularian method of growth. B, C. Incrusting zoaria. (After Smitt, 1872, and Hincks, 1881.) *cry*, cryptocyst; *mb*, mandible; *op*, opesium; *r*, channel of the cryptocyst.

#### SMITTIPORA MIDWAYANICA, new species.

Plate 4, figs. 16–19.

*Description.*—The zoarium is vincular, articulated (?), formed of cylindrical segments containing eight longitudinal series of zooecia. The zooecia are much elongated, hexagonal, confluent through their mural rims; the cryptocyst is deep, very narrow, as long as the opesium, little distinct from the mural rim. The opesium is elliptical.

*Measurements.*—Opesium $\left\{\begin{array}{l} ho=0.16 \text{ mm.} \\ lo=0.08 \text{ mm.} \end{array}\right.$ Zooecium $\left\{\begin{array}{l} Lz=0.34 \text{ mm.} \\ lz=0.16 \text{ mm.} \end{array}\right.$

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[1] Canu, Révision des Bryozoaires du Crétacé figurés par D'Orbigny, Bulletin Société Géologique de France, ser. 3, vol. 28, p. 407.

*Affinities.*—It is not certain that the zoarium was articulated. The only claviform segment (fig. 18) observed contained radicular zooecia at its base; but this might well be considered as the base itself of the zoarium. Nevertheless we have never observed branched segments.

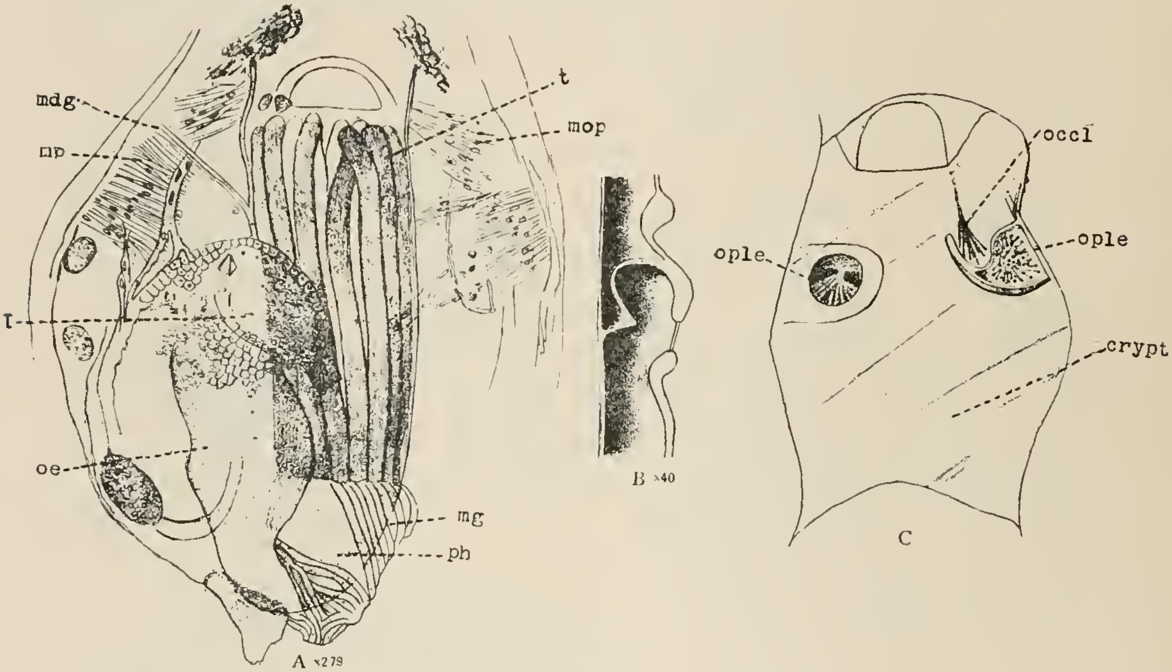


FIG. 60.—Anatomy of the subfamily Microporidae.

A. *Micropora unicifera* Busk, 1884. Sketch showing anatomy of polypide, × 270. (After Jullien, 1888.)

B. *Micropora coriacea* Esper, 1791. Transverse section through the endozooecial ovicell, × 40. (After Levinsen, 1909.)

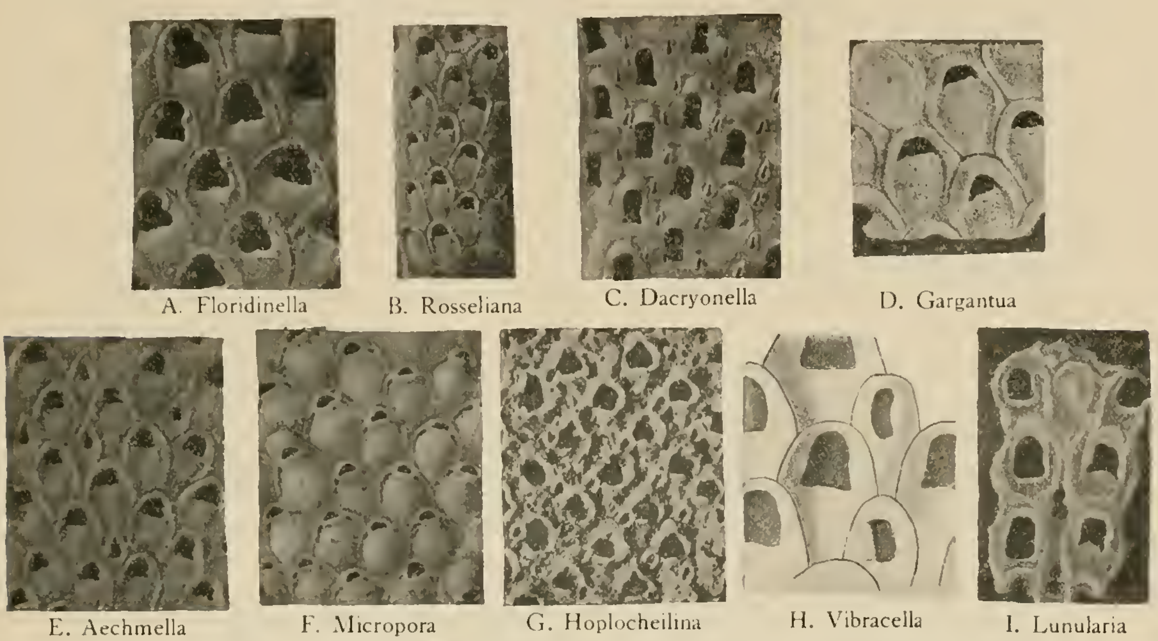
C. Sketch combining frontal (to the left) and basal (to the right) views of *Micropora*. (After Harmer, 1902.)

*crypt*, cryptocyst.
*I*, intestine.
*mdg*, dilator muscles of the tentacular sheath.
*mg*, large retractor muscles of the polypide (of the sheath and of the lophophore).
*mop*, opercular occlusor muscles.
*mp*, parietal muscles.
*occl*, occlusor muscles of the operculum.
*oe*, esophagus.
*ople*, opesiule (frontal view).
*ople'*, opesiule (basal view).
*ph*, pharynx.
*t*, tentacles (10 in number).

This fragile species is very close to *Smittipora* (*Vincularia*) *canalifera* Hagenow, 1851 of the Maestrichtian, from which it differs in its smaller micrometric measurements (*Lz* 0. 34 mm and not 0.44 mm.) and in its elliptical instead of subcircular opesium.

*Occurrence.*—Midwayan (Clayton limestone): Mabelvale, near Little Rock, Arkansas (common); 1 mile west of Fort Gaines, Georgia (rare); 2¾ miles northeast of Ripley, Mississippi (rare); Luverne, Crenshaw County, Alabama (rare).

*Cotypes.*—Cat. No. 63802, U.S.N.M.



A. Floridinella B. Rosseliana C. Dacryonella D. Gargantua

E. Aechmella F. Micropora G. Hoplocheilina H. Vibracella I. Lunularia

FIG. 61.—Genera of subfamilies Microporidae Hincks, 1880, and Lunulariidae Levinsen, 1909.

A. *Floridinella vicksburgica* Canu and Bassler, 1917, × 20. Vicksburgian, one mile north of Monroeville, Alabama.

B. *Rosseliana parvipora*, new species, × 20. Vicksburgian, one mile north of Monroeville, Alabama.

C. *Dacryonella octonaria* Canu and Bassler, 1917, × 20. Middle Jacksonian, Wilmington, North Carolina.

D. *Gargantua bidens* Busk, 1859. Crag of England.

E. *Aechmella filimargo* Canu and Bassler, 1917, × 20. Upper Jacksonian, Escambia County, Alabama.

F. *Micropora coriacea* Esper, 1791, × 20. Middle Jacksonian, Wilmington, North Carolina.

G. *Hoplocheilina spectabilis* Canu, 1911. Rocanean of Argentina.

H. *Vibracella trapezoidea* Reuss, 1864. Priabonian of the Vicentin.

I. *Lunularia distans* Lonsdale, 1845, × 20. Middle Jacksonian, Wilmington, North Carolina.

## Subfamily MICROPORIDAE Hincks, 1880.

*Bibliography (Anatomical).*—1886, JULLIEN, Mission scientifique du Cap Horn, Bryozoaires, vol. 6, pl. 14.—1900, CALVET, Contribution a l'histoire naturelle des Bryozoaires ectoproctes marins, Travaux de l'Institut de Zoologie de l'Université de Montpellier, Mem. No. 8, pl. 8, figs. 11, 12.—1902, HARMER, On the Morphology of the Cheilostomata, Quarterly Journal Microscopical Science, vol. 46, p. 316, pl. 17, fig. 51; pl. 18, figs. 57, 58.—1909, LEVINSEN, Morphological and Systematic Studies on the Cheilostomatous Bryozoa, p. 161, pl. 8, fig. 3.

The ovicell is endozooecial. The parietal muscles, attached to the ectocyst, pass through the calcareous cryptocyst, either by the opesiular indentations or by true perforations called opesiules. The semi-circular aperture has generally a more or less strongly chitinized (or calcareous), simple operculum, more seldom an opercular valve. Avicularia present.

*Historical.*—The family Microporidae as delimited by Hincks and by Jullien does not appear very natural because the ovicell system has not been considered; indeed Levinsen in 1909 made some modifications.

The family may be made more exact by including in it only those genera having an endozooecial ovicell. There is no important difference between the Microporidae and the Onychocellidae; the onychocellaria simply disappear or are replaced by the avicularia.

As Canu in 1900,[1] has demonstrated, the replacement of the onychocellaria by avicularia is constant in the general line of descent. It is simply adaptation to new conditions of existence.

In our opinion, the Onychocellidae and Microporidae with the Lunulariidae form one and the same family for which we have adopted Jullien's name Opesiulidae, but have retained the first three mentioned as subfamilies.

### Genus ROSSELIANA Jullien, 1888.

1888. *Rosseliana* JULLIEN, Mission Scientifique du Cap Horn, Bryozoaires, vol. 6, p. 78.

The frontal of the zooecium is a cryptocyst of little depth. The opesium is semicircular. The ovicell is endozooecial but prominent. Septulae uniporous. No avicularia.

*Genotype.*—*Rosseliana* (*Flustra*) *rosselii* Audouin, 1826.

Canu, in 1900, has badly interpreted Jullien's genus, for the species which he considered as *Rosseliana* are more often typical *Onychocella*.

The fossil species are:

*Rosseliana* (*Membranipora*) *incompta* Reuss, 1874. Miocene.

*Rosseliana* (*Membranipora*) *reussiana* Manzoni, 1874. Miocene, Pliocene.

#### ROSSELIANA PARVIPORA, new species.

Plate 82, fig. 16.

*Description.*—The zoarium incrusts bryozoa. The zooecia are elongated, distinct, separated by a deep furrow; the mural rim is thin, salient, complete, and distinct. The cryptocyst is flat, shallow, much larger than the opesium and very finely granulated; the opesium is semilunate, transverse, with a proximal concave border. The ovicell is endozooecial, protruding, and smooth.

*Measurements.*—Opesium $\begin{cases} ho=0.08 \text{ mm.} \\ lo=0.10 \text{ mm.} \end{cases}$ Zooecium $\begin{cases} Lz=0.34\text{–}0.36 \text{ mm.} \\ lz=0.16\text{–}0.20 \text{ mm.} \end{cases}$

*Affinities.*—There is no polypidian convexity in this species and the opesiular indentations are only visible on rare zooecia. The ovicelled zooecia have a little larger opesium, the breadth of which ranges from 0.12 to 0.14 mm.

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[1] Canu, Revision des Bryozoaires du Crétacé figurés par D'Orbigny, Bulletin Société Géologique de France, ser. 9, vol. 28, p. 345.

This species resembles closely *Rosseliana rosselii* Audouin, 1826, a recent form, which, however, appears first in the Priabonian of Vicentin, Italy. *Rosseliana parvipora* differs, however, in its smaller micrometric measurements ($Lz=0.36$ mm. instead of 0.44 mm.) and principally in its small transverse opesium.

*Occurrence.*—Vicksburgian ("Chimney rock" of Marianna limestone): One mile north of Monroeville, Alabama (rare).

*Holotype.*—Cat. No. 64253, U.S.N.M.

### Genus FLORIDINELLA Canu and Bassler, 1917.

1917. *Floridinella* CANU and BASSLER, Synopsis of American Early Tertiary Cheilostome Bryozoa, Bulletin 96, United States National Museum, p. 28.

The ovicell is endozooecial and separated from the zooecia by a fold The polypidian convexity is not prominent. The opesiular indentations are large and rounded. The opesium is constricted by two symmetrical lateral teeth at the level of the opercular articulation.

*Genotype.*—*Floridinella vicksburgica* Canu and Bassler, 1917.

This genus is a true *Floridina* without onychocellarium. The following species must be classed in this genus:

*Floridinella* (*Marginaria*) *deshayesi* Hagenow, 1851.
*Floridinella* (*Membranipora*) *formosa* Reuss, 1874.

### FLORIDINELLA VICKSBURGICA Canu and Bassler, 1917.

Plate 82, figs. 17–26.

1917. *Floridinella vicksburgica* CANU and BASSLER, Synopsis of American Early Tertiary Cheilostome Bryozoa, Bulletin United States National Museum, p. 28, pl. 3, fig. 3.

*Description.*—The zoarium is unilamellar, hollow, cylindrical, and incrusts the stems or small roots of algae. The zooecia are elongated, distinct, separated by a deep furrow; the mural rim is incomplete, rather broad, distinct from the cryptocyst. The cryptocyst is shallow, smooth, or finely granular, longer than the opesium; the polypidian convexity is but slightly projecting; the opesiular indentations are large, symmetrically rounded; the opesium is elongated, constricted superiorly by two lateral teeth placed at the level of the operculum.

*Measurements.*—Opesium $\left\{\begin{array}{l} ho=0.20 \text{ mm.} \\ lo=0.16 \text{ mm.} \end{array}\right.$ Zooecia $\left\{\begin{array}{l} Lz=0.50 \text{ mm.} \\ lz=0.30\text{–}0.40 \text{ mm.} \end{array}\right.$

*Variations.*—Species with tubular zoaria are quite polymorphic, for the zooecia are easily deformed on account of irregularities in the substratum. In the present species there are wide zooecia (fig. 21) and narrow zooecia (fig. 19). The opesium becomes very small and the opesiules become linear (fig. 22). We have observed some cases of total regeneration (fig. 26) and closed zooecia perforated by a slit or by a pore (fig. 26).

The noncelluliferous face (figs. 23–25) always presents small hydrostatic tuberosities designed to detach the zoarium from the substratum, to creep on the ectocyst, and to increase the volume of the zoarium. Here the zooecia are distinctly marked (figs. 24. 25) or invisible (fig. 23). There are two pairs of lateral septules. The cryptocyst is a compact olocyst with the elements scattered.

*Affinities.*—This form should not be confounded with species of the genus *Amphiblestrum* because it is without avicularia and its ovicell is endozooecial.

The ovicell unfortunately is very rare. On 100 specimens collected only two had ovicells. The great abundance of specimens in the Vicksburgian, to which it seems restricted, has given rise to the specific name.

*Occurrence.*—Vicksburgian (Marianna limestone): One mile north of Monroeville, Alabama (abundant); West bank of Conecuh River, Escambia County, Alabama (abundant); Murder Creek, east of Castlebury, Alabama (abundant); near Claiborne, Monroe County, Alabama (abundant); 2½ miles north of Millry, Washington County, Alabama (abundant).

*Cotypes.*—Cat. No. 64254, U.S.N.M.

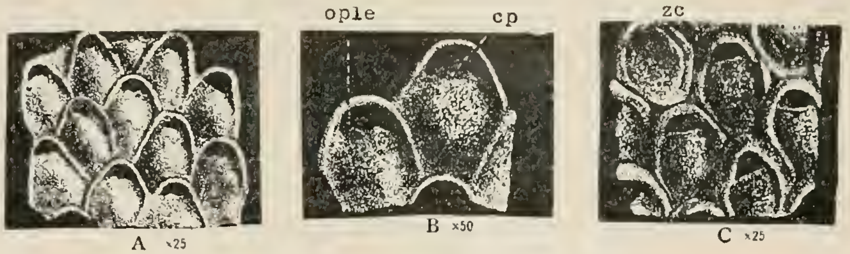

Fig. 62. Genus *Gargantua* Jullien, 1888.

A–C. *Gargantua bidens* Busk, 1859. Three views showing zooecial structure. (After Busk, 1859.) *cp*, polypidian convexity; *ople*, opesiular indentations; *zc*, calcified zooecium.

### Genus GARGANTUA Jullien, 1888.

1888. *Gargantua* Jullien, Mission Scientifique du Cap Horn, Bryozoaires, vol. 6, p. 78.

The polypidian convexity projects but little. The opesiules are incomplete and consist of two small symmetrical indentations. No avicularia.

*Genotype.*—*Gargantua* (*Membranipora*) *bidens* Busk, 1859.

*Range.*—Miocene, Recent.

Jullien took for the type of this genus, *Cellopora* (*Marginaria*) *bidens* Hagenow, 1851, which was figured very imperfectly, but he certainly had before him the beautiful figure given by Busk in 1859. We are not certain of the identity of the Cretaceous form with the Pliocene species.

Furthermore, Waters in his work on Membraniporidae in 1898[1] described and figured a *Membranipora bidens* living off Capri at a depth of 220 meters. This species certainly belongs to the same genus as that of Busk; but it differs in its perforated ovicell, a character which we have never observed on the numerous specimens in our possession of typical *Gargantua bidens* from the Crag.

The recent species ought to be taken as typical of the genus, and it is evident that a more complete study of the whole subject ought to be made. *Gargantua* is

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[1] Journal Linnean Society London, Zoology, vol. 26, p. 681, pl. 49, fig. 1.

*Rosseliana* with clearly marked and constant opesiules. *Membranipora ogivalis* Seguenza 1879 is classed in this genus.

### Genus DACRYONELLA Canu and Bassler, 1917.

1917. *Dacryonella* Canu and Bassler, Synopsis of American Early Tertiary Cheilostome Bryozoa, Bulletin 96, United States National Museum, p. 28.

The polypidian convexity protrudes very little and is inconstant. The opesiules are large, round, lateral indentations. The ovicell is endozooecial. There are no opesial processes (therefore an opercular valve). The opesium is elongated (therefore the parietal muscles are much developed). The avicularia are very small, constant, placed in all the interzooecial angles, and have the form of small tear drops.

*Genotype.*—*Dacryonella octonaria* Canu and Bassler, 1917. Jacksonian.

This is a *Rosseliana* ornamented with avicularia. As in this genus also, the opesiules are inconstant and placed very far from the aperture in consequence of the great development of the parietal muscles.

#### DACRYONELLA OCTONARIA Canu and Bassler, 1917.

Plate 36, figs. 9–20.

1917. *Dacryonella octonaria* Canu and Bassler, Synopsis of American Early Tertiary Cheilostome Bryozoa, Bulletin 96, United States National Museum, p. 28, pl. 3, fig. 4.

*Description.*—The zoarium incrusts small shells or more often creeps over algae; very frequently it consists of many superposed lamellae. The zooecia are somewhat elongated, confluent among themselves, vaguely polygonal; the mural rim is broad, especially below, flat, smooth, oblique. The cryptocyst is terminated distally in a small polypidian convexity. The avicularia are straight, interopesial, triangular, projecting chiefly at the point.

*Measurements.*—Opesia of large zooecia $\begin{cases} ho=0.10 \text{ mm.} \\ lo=0.14 \text{ mm.} \end{cases}$

Large zooecia $\begin{cases} Lz=0.40 \text{ mm.} \\ lz=0.30\text{–}0.40 \text{ mm.} \end{cases}$

Opesia of small zooecia $\begin{cases} ho=0.18 \text{ mm.} \\ lo=0.10 \text{ mm.} \end{cases}$

Small zooecia $\begin{cases} Lz=0.40 \text{ mm.} \\ lz=0.30 \text{ mm.} \end{cases}$

*Variations and affinities.*—The polymorphism of this species is very remarkable. On the same zoarium, without apparent reason, the zooecia are considerably increased in size, chiefly at the extremity of the fronds. The larger zooecia are always grouped together, none of them being isolated; then their opesium becomes transverse and almost triangular.

The polypidian convexity is here symmetrical, but as usual is not constant. However the proximal border of the opesium is nearly always straight or convex and very rarely concave. We know that this phenomenon may be observed in other genera of different families and that it can not serve as a generic character.

The zoarium is more often multilamellar. The lamellae consists of zooecia piled upon zooecia (figs. 11, 14). The outermost zooecia often experience some reduction (fig. 13) or deformations (fig. 17).

The small avicularia are interopesial. They appear almost circular in tangential sections. These same sections also show the olocyst constitution of the zooecial wall (fig. 19).

The inner face of the zoarium exhibits convex hexagonal zooecia bearing the hydrostatic tuberosities. Many of these latter terminate in a small pore whose function is unknown to us (fig. 20).

*Affinities.*—In *Dacryonella minor* the zoarium is bilamellar and free, and its dimensions much smaller. The great persistence of *Dacryonella octonaria* may be attributed to its perfected hydrostatic system.

*Occurrence.*—Middle Jacksonian: Wilmington, North Carolina (abundant); Near Lenuds Ferry, South Carolina (common); Eutaw Springs, South Carolina (rare); 3½ miles north of Grovania, Georgia (rare); 18 miles west of Wrightsville, Johnson County, Georgia (rare).

Upper Jacksonian (Ocala limestone): 7 miles above Bainbridge, Georgia (common); Old Factory, 1½ miles above Bainbridge, Georgia (common); West bank of Sepulga River, Escambia County, Alabama (common); Chipola River, east of Marianna, Jackson County, Florida (rare); 9 miles north of Ocala, Florida (rare); Alachua, Florida (rare).

Jacksonian (Zeuglodon zone): South side of Suck Creek, Clarke County, Mississippi (rare).

*Cotypes.*—Cat. Nos. 62584, 63987–63990, U.S.N.M.

### DACRYONELLA MINOR, new species.

Plate 36, figs. 7, 8.

*Description.*—The zoarium is free, bifurcated, and formed of two lamellae placed back to back. The zooecia are small, elongated, indistinct, confluent; the marginal rim is broad, flat, enlarged at the base into a concave cryptocyst. The opesium is entire, subelliptical with a straight or convex proximal border; the polypidian convexity is very inconstant. The ovicell is a very small distal convexity. The avicularia are triangular and project but slightly.

*Measurements.*—Zooecia $\left\{\begin{array}{l} Lz=0.14 \text{ mm.} \\ lz=0.09 \text{ mm.} \end{array}\right.$

*Affinities.*—Although quite variable the polypidian convexity is actually present as in *Dacryonella octonaria*, but the small dimensions and the free zoarium distinguish the two species very well.

*Occurrence.*—Upper Jacksonian (Ocala limestone): Chipola River, east of Marianna, Jackson County, Florida (common).

*Cotypes.*—Cat. No. 63986, U.S.N.M.

### Genus AECHMELLA Canu and Bassler, 1917.

1917. *Aechmella* Canu and Bassler, Synopsis of American Early Tertiary Cheilostome Bryozoa, Bulletin 96, United States National Museum, p. 29.

The polypidian convexity is little prominent. The opesiules are round, lateral indentations. The opesium is often contracted by two lateral teeth at the level of the opercular hinge. The ovicell is endozooecial. The avicularium is interzooecial, smaller than a zooecium, lozenge shaped, with the form of the head of a lance.

*Genotype.*—*Aechmella filimargo* Canu and Bassler, 1917.

*Range.*—Cenomanian-Miocene.

The genus *Aechmella* is in effect *Gargantua* with avicularia. It may also be regarded as *Floridina* with avicularia replacing the onychocellaria.

The species of the genus are:

*Aechmella* (*Cellepora*) *michaudiana* D'Orbigny, 1850.
*Aechmella* (*Cellepora*) *hippocrepis* Hagenow, 1851.
*Aechmella* (*Cellepora*) *roemeri* Lonsdale.
*Aechmella* (*Cellepora*) *xiphia* D'Orbigny, 1852.
*Aechmella* (*Cellepora*) *xanthe* D'Orbigny, 1852.
*Aechmella* (*Cellepora*) *urania* D'Orbigny, 1852.
*Aechmella* (*Membranipora*) *depressa* MacGillivray, 1904.
*Aechmella* (*Membranipora*) *concinna* MacGillivray, 1904.
*Aechmella* (*Membranipora*) *ambigua* MacGillivray, 1904.

It is probable that one part of *Homalostega* Marsson, 1887, may be classed in this genus.

### AECHMELLA CRASSIMARGO, new species.

Plate 37, figs. 1, 2.

*Description.*—The zoarium incrusts shells. The zooecia are small, slightly elongated, joined by their mural rims; the mural rim is incomplete, projecting in front, thick on the *borders*, distinct from the cryptocyst. The cryptocyst is shallow, a little convex, and smooth; the opesium is almost transverse, trifoliate, contracted by two lateral teeth at the level of the opercular pivot; the polypidian convexity is scarcely visible; the opesiular indentations are shallow and symmetrical. The ovicell is endozooecial. The ancestrula is a small zooecium of the same form as the normal ones. The avicularium ir interzooecial, smaller than the zooecia, lozenge-shape, with a small distal canalicule and an elliptical opesium.

*Measurements.*—Opesium $\begin{cases} ho=0.08\text{–}0.10 \text{ mm.} \\ lo=0.12\text{–}0.14 \text{ mm.} \end{cases}$

Zooecium (including the opesiular indentations) $\begin{cases} Lz=0.32\text{–}0.40 \text{ mm.} \\ lz=0.24\text{–}0.30 \text{ mm.} \end{cases}$

*Affinities.*—We have observed only a small number of specimens which were thought for a while to represent forms of ancestrular zooecia of *Aechmella filimargo*. Nevertheless, we now believe it necessary to consider this a distinct species on account of the thickness of the mural rim and the elliptical form of the avicularian opesium.

*Occurrence.*—Middle Jacksonian: Near Lenuds Ferry, South Carolina (rare); Eutaw Springs, South Carolina (rare).

*Cotypes.*—Cat. No. 63991, U.S.N.M.

### AECHMELLA FILIMARGO Canu and Bassler, 1917.

Plate 37, figs. 3–5.

1917. *Aechmella filimargo* Canu and Bassler, Synopsis of American Early Tertiary Cheilostome Bryozoa, Bulletin 96, United States National Museum, p. 29 pl. 3, fig. 5.

*Description.*—The zoarium incrusts Orbitoides. The zooecia are elongated, distinct, separated by a furrow or united by their mural rims: the mural rim is *thin*, incomplete, convex, distinct from the cryptocyst. The cryptocyst is shallow, oblique toward the opesium, flat, finely granulose: the opesium is transverse, constricted by two lateral teeth at the level of the rotary axis of the operculum; the polypidian convexity projects but little: the opesiular indentations are large, round, and symmetrical. The ovicell is endozooecial and small. The ancestrula is a small zooecium, but otherwise identical with the others. The avicularium is interzooecial, smaller than the zooecia, lozenge-shaped, with a small distal canal and a round opesium.

*Measurements.*—Opesium $\begin{cases} ho=0.12 \text{ mm.} \\ lo=0.16 \text{ mm. (including the opesiules)} \end{cases}$

Marginal zooecia $\begin{cases} Lz=0.50 \text{ mm.} \\ lz=0.30 \text{ mm.} \end{cases}$

*Affinities.*—This species differs from *Rhagasostoma levigatum* in having an endozooecial ovicell. It may be distinguished from *Aechmella crassimargo* by its filiform mural rim.

Very often the proximal border of the opesium is simply undulated and the opesiules are visible only on account of the opesiular teeth. The opesia of the ovicelled zooecia seem a little larger than the others.

*Occurrence.*—Upper Jacksonian (Ocala limestone): West bank of Sepulga River, Escambia County, Alabama (rare).

*Cotypes.*—Cat. No. 62555, U.S.N.M.

### Genus MICROPORA Gray, 1848.

1848. *Micropora* Gray, Catalog List British Animals in British Museum, pt. 1, Centroniae, p. 115.

The two opesiules, which are more or less constant, have the form of simple perforations. Spines may appear. The ovicells are endozooecial, but very prominent, and the small avicularia, which are situated proximally in the aperture, are furnished with a complete crossbar (after Levinsen). Dietellae with few pores.

*Genotype.*—*Micropora* (*Flustra*) *coriacea* Esper, 1791.

*Range.*—Midwayan.—Recent.

The species of the genus are:

*Micropora coriacea* Esper, 1791.
*Micropora perforata* MacGillivray, 1859.
*Micropora normani* Levinsen, 1909.
*Micropora brevissima* Waters, 1904.
*Micropora minuta* Reuss, 1874.

### MICROPORA CORIACEA Esper, 1791.

Plate 4, figs. 20–22.

*Bibliography* (*Zoological*).

1791. *Flustra coriacea* Esper, Die Pflanzenthiere, etc., ou Histoire naturelle des Zoophytes pl. 7, fig. 2.

1852. *Flustra coriacea* Landsborough, A popular history of British Zoophytes or Corallines, p. 353.

1816. *Discopora coriacea* Lamarck, Histoire naturelle des animaux sans vertebres, ed. 2. vol. 1, p. 168; idem. 1836, vol. 2, p. 251.

1824. *Discopora coriacea* Lamouroux. Encyclopedie Méthodique. Histoire Naturelle des Zoophytes ou Animaux Rayonnes, vol. 14, p. 255.

1830. *Discopora coriacea* Blainville, Dictionnaire des Sciences Naturelles, vol. 60, p. 411.

1830. *Discopora coriacea* Blainville, Manuel d'Actinologie ou de Zoophytologie, p. 446.

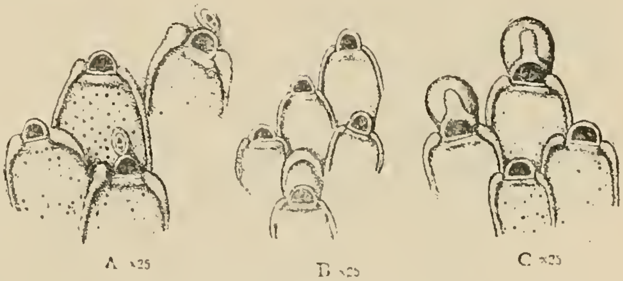

Fig. 63.—Genus *Micropora* Gray, 1848.

A–C. *Micropora coriacea* Esper, 1791. Three views, × 25, showing structure of this species. (After Hincks, 1880.)

1848. *Micropora coriacea* Gray, List of British animals in the collection of the British Museum, p. 115.

1854. *Membranipora coriacea* Busk, Catalogue of the Marine Polyzoa in the collection of the British Museum, pt. 2, p. 57.

1872. *Micropora coriacea* Smitt, Floridan Bryozoa . . . Kongl. Svenska Vetenskaps-Akademiens Handlingar, vol. 10, No. 11, p. 13.

1880. *Micropora coriacea* Hincks, A History of the British Marine Polyzoa, p. 174.

1884. *Micropora coriacea* Busk, Report on the Polyzoa collected by the *Challenger*, Report on the Scientific Results of the voyage of H. M. S. *Challenger*. Zoology, pt. 1, vol 10, pt. 30, p. 71.

1888. *Micropora coriacea* Kirkpatrick, Polyzoa from Port Philip, Victoria, Annals Magazine Natural History, ser. 6, vol. 2, p. 75.

1887. *Micropora coriacea* MacGillivray, A Catalogue of the Marine Polyzoa of Victoria. Transactions and Proceedings of the Royal Society of Victoria, vol. 23, p. 209.

1889. *Micropora coriacea* Jelly, A Synonymic Catalogue of Marine Bryozoa, p. 176.

1889. *Micropora coriacea* Waters, Bryozoa from Madeira, Journal Royal Microscopical Society, p. 16.

1904. *Micropora coriacea* Waters, Antartique Voyage du *Belgica*, p. 39.

1908. *Micropora coriacea* ROBERTSON, The incrusting cheilostomatous Bryozoa of the west coast of North America, University of California Publications, Zoology, vol. 4, p. 275, pl. 17, fig. 26 (Bibliography).

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1862. *Reptescharellina disparilis* GABB and HORN, Journal Academy Natural Science, Philadelphia, ser. 2, vol. 5, p. 147, pl. 20, fig. 29.

1869. *Membranipora gracilis* REUSS, Die fossilen Anthozoen und Bryozoen der Schichtengruppe von Crosaro, Denkschriften der k. Akademie der Wissenschaften, Wien, vol. 59, Abth. 1, vol. 29, p. 291, pl. 29, fig. 13.

1891. *Micropora coriacea* WATERS, North Italian Bryozoa, Quarterly Journal of the Geological Society of London, vol. 47. p. 13, pl. 11, fig. 9.

1896. *Micropora coriacea* PERGENS, Bryozoaires des environs de Buda, Bulletin Société Belge de Geologie, vol. 10, p. 365.

1896. *Micropora* (*Peneclausa*) *coriacea* NEVIANI, Briozoi postpliocenici di Spilinga (Calabrie), Atti Academia Gioenia di Scienze, Naturali in Cantania, ser. 4, vol. 9, p. 17, fig. 3.

1900. *Micropora* (*Peneclausa*) *coriacea* NEVIANI, Briozoi i neogenici delle Calabrie, Paleontographia italica, vol. 6, p. 166 (Italian bibliography).

1904. *Micropora coriacea* CANU, Les Bryozoaires du Patagonien, Memoires Société Geologique de France, vol. 12, No. 32, p. 10, pl. 1, fig. 15.

1905. *Micropora* (*Peneclausa*) *coriacea* NEVIANI, Briozoi fossile di Carrubare (Calabrie), Bollettino della Societá geologica italiana, ser. 2, vol. 8, p. 521.

1906. *Micropora gracilis* CANU, Bryozoaires des Terrains du Sud-Ouest de la France, I, Aquitanien, Bulletin Société Geologique de France, ser. 4, vol. 6, p. 513, pl. 12, fig. 10.

1910. *Micropora coriacea* CANU, Bryozoaires des Terraines du Sud-Ouest de la France, Bulletin Société Geologique de la France, ser. 4, vol. 10, p. 845.

This species has been known for a long time in America, where Gabb and Horn described it under the name of *Reptescharellina disparilis*. More recently Canu has noted it in the Patagonian of Argentina. In Europe, Waters observed the species in the Priabonian. As the living examples are found at Madeira and in the Gulf of Mexico, its presence in American Eocene strata was inevitable. Without ever being abundant it has been collected at a number of localities.

We have already called the attention of the reader to this peculiarity of occurrence, and we will later note still other examples. It is apparent that the course of the great Atlantic currents was at the end of the Eocene absolutely identical with that prevailing today. We lack bryozoan material from the middle Eocene in America and the lower Eocene in Europe, so that this problem can not be studied for the beginning of Eocene time.

*Variations.*—The opesiules in the fossil forms of *Micropora coriacea* are often closed by fossilization. The ancestrula is unfortunately broken on the beautiful specimen from Wilmington, North Carolina, figured. The ovicell is endozooecial, but very prominent and always visible. The cryptocyst is smooth or very finely granulated.

*Measurements.*—Opesium $\begin{cases} ho=0.08 \text{ mm.} \\ lo=0.14 \text{ mm.} \end{cases}$ Zooecium $\begin{cases} Lz=0.50\text{–}0.62 \text{ mm.} \\ lz=0.38 \text{ mm.} \end{cases}$

These micrometric measurements differentiate it clearly from *Micropora minuticella* which is exceptionally small.

*Occurrence.*—Midwayan (Clayton limestone): One mile west of Fort Gaines, Georgia (very rare).

Middle Jacksonian (Castle Hayne limestone): Wilmington, North Carolina (rare).

Upper Jacksonian (Ocala limestone): 1½ miles above Bainbridge, Georgia; 4 miles below Bainbridge, Georgia; 7 miles above Bainbridge, Georgia; Chipola River, east of Marianna, Florida.

Vicksburgian (Marianna limestone): West bank of Conecuh River, Escambia County, Alabama (rare); deep well, Escambia County, Alabama; near Claiborne, Alabama (rare); Salt Mountain, 5 miles south of Jackson, Alabama (rare).

Postpliocene: Santa Barbara, California (Gabb and Horn).

Patagonian: Argentina (Canu).

*Geological distribution.*—Auversian of France (Canu); Priabonian of the Vicentin (Reuss, Waters), of Hungary (Pergens); Aquitanian of France (Canu); Burdigalian of France (collection Canu); Sicilian and Quaternary of Italy (Neviani).

*Habitat.*—Atlantic: Off France, England, Azore Islands, Madeira and Florida (36–136 fathoms,). Mediterranean (80 meters). Antarctic (500 meters). Pacific: Off Queen Charlotte Island and California (45 fathoms). In the Antarctic the species lives at a temperature of 9° Centigrade.

*Plesiotypes.*—Cat. Nos. 63803, 63804, U.S.N.M.

### MICROPORA MINUTICELLA, new species.

Plate 4, fig. 23.

*Description.*—The zoarium incrusts small shells. The zooecia are *small*, distinct, separated by a furrow, elongated; the cryptocyst is shallow, very finely granulated; the mural rim is thin, distinct, nearly complete; the aperture is semilunar, transverse, surrounded by a peristome. The ovicell is smooth and endozooecial. A pair of very small lateral opesiules is present.

*Measurements.*—Aperture $\begin{cases} ho=0.04 \text{ mm.} \\ lo=0.07 \text{ mm.} \end{cases}$ Zooecium $\begin{cases} Lz=0.25\text{–}0.27 \text{ mm.} \\ lz=0.20 \text{ mm.} \end{cases}$

*Affinities.*—This is the smallest of the known species of *Micropora*. Its anoestrula, however, is not much smaller than the other zooecia.

*Occurrence.*—Midwayan (Clayton limestone): One mile west of Fort Gaines, Georgia (very rare).

*Holotype.*—Cat. No. 63805, U.S.N.M.

### Genus HOPLOCHEILINA Canu, 1911.

1911. *Hoplocheilina* Canu, Iconographie des Bryozoaires fossiles de l'Argentine, pt. 2, Anales del Museo Nacional de Buenos Aires, vol. 21, p. 261.

The polypidian convexity is little salient. The opesiules are round, indentations of little depth. The opesium is ogival. The cryptocyst is little deep. The ovicell is endozooecial. There are two large, oral avicularia.

*Genotype.—Hoplocheilina spectabilis* Canu, 1911.

*Range.—Cenomanian-Maestrichtian.*

The species of this genus are:

*Hoplocheilina* (*Eschara*) *osculifera* Reuss, 1877. Cenomanian, Germany.

*Hoplocheilina* (*Eschara*) *ichnoidea* Hagenow, 1851, Maestrichtian, Belgium.

*Hoplocheilina* (*Reptescharellina*) *prolifera* Gabb and Horn, 1862, Danian of New Jersey.

*Hoplocheilina* (*Lepralia*) *russelli* Pergens, 1893. Maestrichtian, Belgium.

*Hoplocheilina spectabilis* Canu, 1911, Rocanean, Argentina.

## Subfamily LUNULARIIDAE Levinsen, 1909.

The zoarium is a Lunulites—that is, a conical, cupuliform disk. Vibracula are present. The opesiular indentations are very inconstant.

The only known genus is *Lunularia*, the structure of which is described below as a result of our own studies.

### Genus LUNULARIA Busk, 1884.

1884. *Lunularia* Busk, Report on Polyzoa collected by *Challenger*, Cheilostomata, vol. 10, pt. 30, p. 208.

The zoarium has the Lunulites form. The avicularia are symmetrical. Exteriorly and interiorly the zooecia are arranged in radial rows. The cryptocyst is more or less developed. Both radicular and hydrostatic zooecia are present. The ovicell is endozooecial.

*Genotype.—Lunulites capulus* Busk, 1884.

*Range.*—Cenomanian—Recent.

*Historical.—Lunulites* Lamarck 1812 is not a definite generic type, but is merely a zoarial form adopted for certain reasons. This style of growth obtains in many genera of cheilostomatous bryozoa, as *Otionella* and *Trochopora* in the *Anasca Malacostega; Lunularia* and *Selenaria* in the *Anasca Coilostega* and *Stichopora*, *Fedora*, and *Bipora* in the *Ascophora.*

All of the fossils hitherto grouped under the general name of *Lunulites* must now be classified according to their affinities. In 1900, Canu made the first and timid attempt. In 1912, Waters brought forth anatomical proof, which will be cited when the occasion demands.

*Structure of the Lunulites.*—The hydrostatic zoarial system of the *Lunulites* bryozoa is very complicated and we are still ignorant of many of the details. The larva ordinarily attaches itself firmly on a grain of sand. The ancestrula which is derived from it immediately gives rise to some closed hydrostatic zooecia which by their lightness permit the zoarium to commence its growth by ascending away from the sand dangerous to its development. (Aborted zooecia of D'Orbigny.) When in the vicinity of algae, the zoarium remains fixed under their fronds. When they do not offer sufficient shelter, the closed zooecia transform themselves into perforated, calcified zooecia which are radicular; the radicles then attach the zoarium to shells, stones, or small algae. The zoarium continues to develop in a more or less widened cone and always with the apex below. It maintains its normal position by the aid of long articulated filaments called vibracula, which are thus organs for the maintenance of stability.

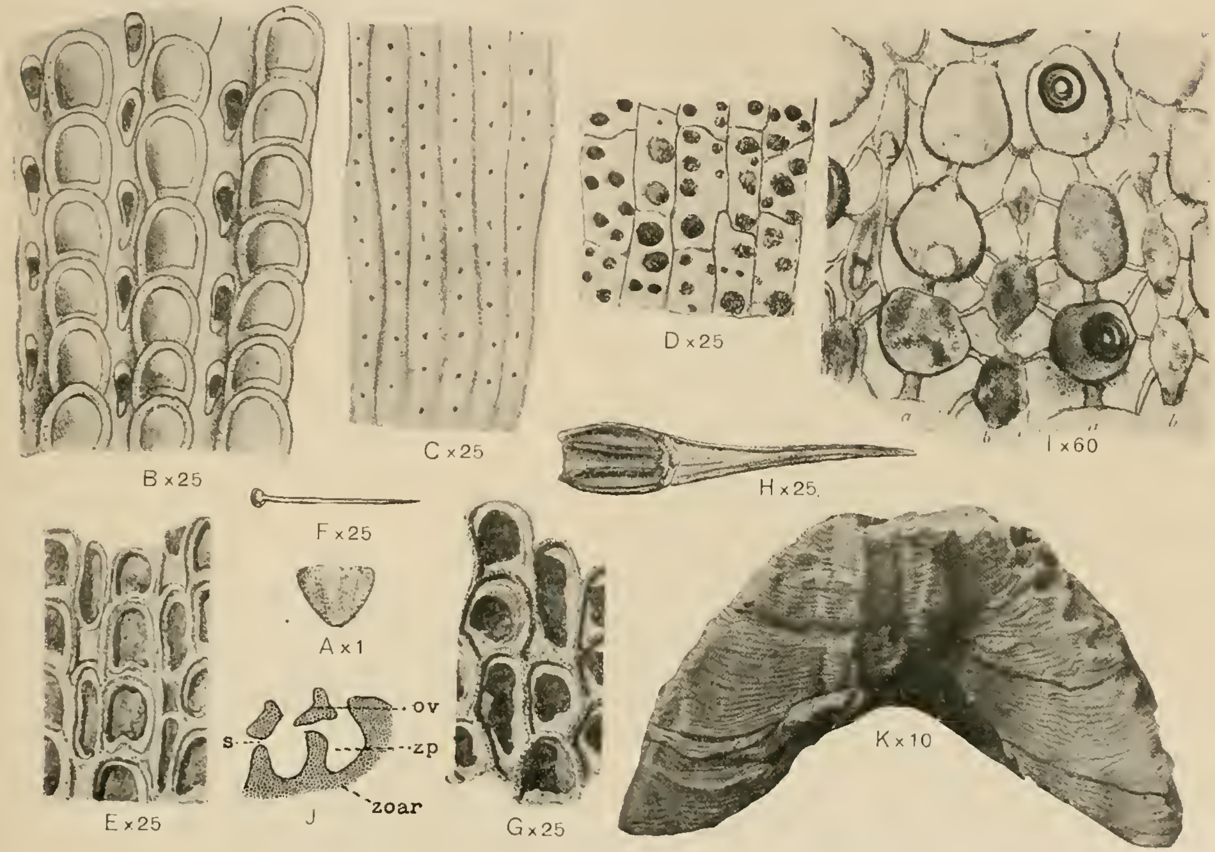


FIG. 64.—Subfamily Lunulariidae Levinsen, 1909.

A–C. *Lunularia capulus* Busk, 1884. A. Zoarium, natural size. B, C. Outer (celluliferous) and inner faces of the zoarium, × 25. (After Busk, 1884.)

D–F. *Lunularia patelliformis* Maplestone, 1903. D. Inner face, × 25. E, F. Vibracular cavity and vibraculum, × 25. (After Maplestone, 1903.)

G, H. *Lunularia repandus* Maplestone, 1903. Vibracular cavity and vibraculum, × 25. (After Maplestone, 1903.)

I. Internal cast of *Lunularia hagenowi* Bosq, 1851. (After Beissel, 1865.)

J. Vertical section of *Lunularia*, traversing an ovicelled zooecium. *ov*, ovicell; *s*, septula; *zoar*, zoarium; *zp*, proximal zooecium.

K. Vertical fracture of *Lunularia tintinabula*, new species, × 10, showing that the zoarium is composed of plurilamellar segments commencing at the center or at a bifurcation.

The choice of a substratum by the larvae is instinctive but not infallible. Often they affix themselves on very heavy objects on which, nevertheless, the zoarium developes. (*Reptolunulites* of D'Orbigny.)

As they are a form of floating life, the *Lunulites* are subject to variations from hydrostatic pressure quite as much as the more mobile fish. To avoid this the zoarium increases or diminishes its volume by the aid of parietal muscles attached to the ectocyst; it also increases its volume by the development of tuberosities on its noncelluliferous face or by special tubules on the same face. This organization, infinitely varied in details, permits the animal to be assured of its existence under a rather constant depth of water and to avoid the great strain of hydrostatic pressure.

*Geological distribution.*—Many Cretaceous *Lunulites* are possessed of opesiular indentations and endozooecial ovicells and consequently ought to be classed in the genus *Lunularia*. The figures of the authors are often inaccurate and it is necessary to have recourse to direct observation. By this means we have established that the following species are true species of *Lunularia:*

*Lunulites plana* D'Orbigny, 1852.
*Pavolunulites elegans* D'Orbigny, 1852.
*Pavolunulites costata* D'Orbigny, 1852.
*Lunulites munsteri* Hagenow, 1851 (=*L. patelliformis* Marsson, 1877).
*Lunulites radiata* Lamark, 1816.
*Lunulites urceolata* Cuvier, 1822.
*Lunulites beisseli* Marsson, 1887.
*Lunulites salebrosa* Marsson, 1887.
*Lunulites goldfussi* Hagenow, 1851.

*Structure of the ovicell.*—The ovicell is truly endozooecial and closed by the opercular valve. Because of the elevation of the zooecial axis it forms only a small distal cavity underneath the operculum and is situated on an enlargement of the distal zooecium (pl. 83, fig. 2). On account of its minuteness the ovicell has escaped observation, but with a little attention it is easy to discover it and to do so rather frequently.

*Zoarial growth.*—The zoarial growth is very different from *Trochopora*, which increases in size by successive disks. It is made by pluricellular segments radiating from the zoarial center (pl. 83, fig. 8) or from a bifurcation (pl. 13, fig. 12). This is quite visible chiefly on the fractures (pl. 83, fig. 7), but it may also be seen on the sections (pl. 83, fig. 10).

### LUNULARIA REVERSA Ulrich, 1901.

Plate 1, figs. 17–19.

1901. *Lunulites reversa* ULRICH, Maryland Geological Survey, Eocene, p. 217, pl. 60, figs. 19, 20.

*Description.*—Zoarium flabellate (perhaps originally discoid or depressed conical). Zooecia subquadrate or pentagonal, usually widest in the anterior half, arranged in rather irregular radiating lines, about six in 2 mm., with an impressed line separating the rows; area depressed, its surface grano-lineate. Margin strongly raised, thick, and straight or slightly concave across the posterior end and much thinner along the sides, the anterior end appearing to be overlapped by the posterior ridge of the next succeeding zooecium. Aperture surrounded by a thickened rim, generally rounded in front and straighter behind, sometimes subquadrate, its anterior border close to the prominent end of the next cell, and the length and width averaging about half the corresponding dimensions of the entire zooecium.

Vibracular cells fusiform or elongate oval, rather large, one usually at each angle of junction between four zooecia. A constriction occurs near the center of each, sometimes on one side only, at other times on both. A narrow area may surround the opening. Under surface marked by irregular depressed lines radiating from the narrow lower extremity of the zoarium. Between these lines the surface is convex and rather coarsely pitted and granulate. (After Ulrich.)

The vibraculum is symmetrical and has two lateral condyles. The figured specimen has no opesiular indentations. However, the presence of the calcified cryptocyst is an indication that the parietal muscles are really attached to the ectocyst.

*Occurrence.*—Lowest Eocene (Bryozoan bed at base of Aquia formation): Upper Marlboro, Maryland (rare).

*Plesiotype.*—Cat. No. 63799, U.S.N.M.

### LUNULARIA OVATA, new species.

Plate 9, figs. 11, 12.

*Description.*—The zoarium is a slightly convex Lunulites, bearing at the center a large number of hydrostatic zooecia. The polypidian zooecia form the four or five exterior, circular rows; they are hexagonal, little distinct, elongated; the mural rim, smooth and thick, is distinct from the little developed cryptocyst; the opesium is elongated, *oval*, the narrow end in front, entire. The ovicell is a small, indistinct distal convexity. The vibracula are arranged in distinct and regular rows; they are interzooecial, symmetrical, fusiform, without lateral condyles. On the inner side the ribs are disposed in longitudinal series under the hydrostatic zooecia and in radial series under the polypidian zooecia. They are furnished with many rows of tuberosities.

*Measurements.*—Opesia $\begin{cases} ho=0.15\text{ mm.} \\ lo=0.12\text{ mm.} \end{cases}$ Zooecia $\begin{cases} Lz=0.25\text{ mm.} \\ lz=0.23\text{ mm.} \end{cases}$

Vibracula $\begin{cases} Lv=0.25\text{–}0.30\text{ mm.} \\ lv=0.16\text{ mm.} \end{cases}$

*Affinities.*—This species is the American representative of *Lunularia radiata* Lamarck 1818, a common species in the Parisian Lutetian, but it is much smaller in zooecial dimensions.

It differs from *Lunularia verrucosa* in its oval opesium and in the large tuberosities which ornament the sides of the inner face.

*Occurrence.*—Wilcoxian (Bashi division): Woods Bluff, Alabama (rare).

*Cotypes.*—Cat. No. 63834, U.S.N.M.

### LUNULARIA? GRANDIPORA, new species.

Plate 12, figs. 3, 4.

*Description.*—The zoarium is probably a slightly convex Lunulites. The zooecia are disposed in radial and circular rows; they are *large*, elongated, distinct, separated by a furrow, and are without cryptocyst; the mural rim is thin, complete, nearly level, with the summit sharp. The opesium is irregularly elliptical, very finely crenulated. The ovicell is typically endozooecial, very distinct, somewhat convex and separated from the mural rim. The vibracula are arranged in distinct rows; they are interzooecial, elliptical, symmetrical, and bear in their distal half two lateral condyles. On the inner side the ribs are convex and bear large tuberosities.

*Affinities.*—*Lunularia grandipora* differs from the other species of the genus *Lunularia* in certain essential characters which fact makes us doubt its position in the genus; the *large* opesium is that of the Membranipores; the ovicell is not of the ordinary type, but is the typical endozooecial ovicell which we have observed in one group of Membranipores; finally, the vibraculum itself, although symmetrical, is elliptical and not lozenge-shaped and fusiform. We are probably dealing with an especial genus which must be classified near *Vibracellina* from which it differs in its orbicular zoarium and its symmetrical nonauriculated vibracula.

Only three fragments of this interesting species have been collected, which is far too few upon which to base a new genus.

*Occurrence.*—Claibornian (Lisbon formation): Wautubbee Hill, 4 miles south of Enterprise, Clarke County, Mississippi (rare).

*Holotype.*—Cat. No. 63840, U.S.N.M.

### LUNULARIA VERRUCOSA, new species.

Plate 37, figs. 6–9.

*Description.*—The zoarium is a convex Lunulites bearing at the center a large number of closed hydrostatic zooecia quite *verrucose.* The polypidian zooecia are distinct, separated by a furrow, rectangular, transverse; the mural rim is little distinct from the cryptocyst and is somewhat projecting; the cryptocyst is much larger than the opesium, shallow, flat, and smooth; the opesium is elliptical and transverse with a proximal border sometimes convex. Its vibracula are arranged in special rows; they are small, lozenge-shaped, and without lateral condyles. On the inner side the ribs are flat, radial, and a little granulated on certain zoaria.

*Measurements.*—Opesia $\left\{\begin{array}{l} ho=0.10 \text{ mm.} \\ lo=0.07 \text{ mm.} \end{array}\right.$ Zooecia $\left\{\begin{array}{l} Lz=0.24 \text{ mm.} \\ lz=0.25\text{–}0.30 \text{ mm.} \end{array}\right.$

Vibracula $\left\{\begin{array}{l} Lv=0.15 \text{ mm.} \\ lv=0.07 \text{ mm.} \end{array}\right.$

*Affinities.*—This species also belongs to the group of *Lunularia radiata* Lamarck from which it differs in its very small zooecial dimensions.

It differs from *Lunularia ovata* because its opesium is transverse and not oval, and by the sides of the inner face, which are flat and almost smooth.

De Gregorio in his Monograph on the Eocene of Alabama has created for the group containing *L. radiata* Lamarck, 1816, *L. fenestrata* De Gregorio, 1890, and *L. punctata* Leymerie, 1845, a special genus *Dimiclausa*, in which *L. ovata* and *L. verrucosa* could be introduced. The essential character is the presence of hydrostatic cellules (cellulis medianis clausia). It is undeniable that the group of species just cited forms a rather homogenous assemblage characterized chiefly by the great development of the calcareous cryptocyst. But, though the hydrostatic cellules may be constant, they are not peculiar to it, for not only do they exist on many other species of *Lunularia*, but they have the same constancy in the genus *Trochopora*, where the mode of growth is totally different. These species of *Lunularia* are perhaps identical or closely related forms, but they do not have different functions from other species, so that they can not be separated generically.

In the interior (fig. 9) the zooecia exhibit a convexity, often supporting the ovicell. This convexity is characteristic of the genus.

The larva always attached itself to a large grain of sand, which fact explains the large number of hydrostatic zooecia permitting the zoarium to lighten itself and thus escape the dangerous zone of the sand.

In the transverse sections the very thick zoarium is formed of many celled segments radiating from the center or from a bifurcation.

*Occurrence.*—Middle Jacksonian: Wilmington, North Carolina (common); Rich Hill, Crawford County, Georgia; 18 miles west of Wrightsville, Johnson County, Georgia (rare); 12 miles southeast of Marshallville, Georgia (rare): Baldock, Barnwell County, South Carolina (rare); 3¼ miles south of Perry, Georgia (rare).

Upper Jacksonian (Ocala limestone): Chipola River, east of Marianna, Florida (rare); Bainbridge, Georgia (rare).

Vicksburgian ("Chimney rock" of Marianna limestone): One mile north of Monroeville, Alabama.

*Cotypes.*—Cat. Nos. 63992, 63993, U.S.N.M.

### LUNULARIA LIGULATA, new species.

Plate 13, figs. 10–12.

*Description.*—The zoarium is a concave Lunulites, much expanded. The zooecia are rectangular, transverse, distinct; the mural rim is thick and distinct from the cryptocyst, which is deep, smaller than the opesium, and very finely granulated. The opesium, orbicular or elliptical, is surrounded by a prominent collar. The ovicell is a large distal convexity. The hydrostatic zooecia have a false opesium partially obstructed by a wide calcarcous *tongue*. The vibracula are elongated, narrow fusiform, deeply embedded, disposed in distinct rows. The inner side has flat or slightly convex radial ribs, perforated with small, scattered pores.

*Measurements.*—Opesia $\begin{cases} ho=0.16 \text{ mm.} \\ lo=0.14 \text{ mm.} \end{cases}$ Zooecia $\begin{cases} Lz=0.20 \text{ mm.} \\ lz=0.30 \text{ mm.} \end{cases}$

Vibracula $\begin{cases} Lv=0.20 \text{ mm.} \\ lv=0.10 \text{ mm.} \end{cases}$

*Variations.*—The hydrostatic zooecia which surround the ancestrula are very variable. The small tongue, which partially obstructs the false opesium, is more or less developed; it becomes transformed into a median column and it is then bordered by four small symmetrical pores. It is evident that the lateral fissures are opesiules through which the parietal muscles pass.

*Affinities.*—This species differs from *Lunularia verrucosa* in its larger micrometric dimensions and in its hydrostatic zooecia, which are not wartlike, but are ornamented with a small tongue.

Although closer still to *Lunularia radiata* Lamarck 1816, it differs from it in its smaller micrometric measurements ($Lz=0.20$ mm. instead of 0.36 mm.), and in its transverse, and not elongated zooecia, and in its hydrostatic zooecia furnished with a tongue.

It belongs to the group *Dimiclausa* De Gregorio, 1890, for which we have as yet no constant characteristics.

*Occurrence.*—Lower Jacksonian: 3½ miles southeast of Shell Bluff post office, Georgia ( rare).

Claibornian (Cook Mountain formation): Moseleys Ferry, Caldwell County, Texas (very common).

Lower Jacksonian (Moodys marl): Jackson, Mississippi (abundant).

Jacksonian (Zeuglodon zone): Bluff on south side of Suck Creek, Clarke County, Mississippi.

Vicksburgian (Red Bluff clay): Red Bluff, Wayne County, Mississippi (rare).

*Cotypes.*—Cat. No. 63846, U.S.N.M.

### LUNULARIA FENESTRATA De Gregorio, 1890.

Plate 37, figs. 10–13.

1890. *Dimiclausa fenestrata* De Gregorio, Monographie de la Faune Eocenique de Alabama. Annales de Geologie, et de Paleontologie, Livraisons 7, 8, p. 249, pl. 42, figs. 23–27.

*Description.*—The zoarium is a small, convex, expanded Lunulites with the zooecia and vibracula in distinct, alternating radial rows. The zooecia are rectangular, somewhat transverse, distinct, ogival; the mural rim is thick; the cryptocyst very small; the opesium large, elongated, elliptical. The ovicell is a large distal convexity. The ancestrular zooecia are hydrostatic and calcified with four opesiular openings like a window. The vibraculum is long, narrow, fusiform, deep, primoserial in the middle, but in distinct rows along the margins. The inner side is formed of large, radial, convex ribs with small pores far apart. A large, distal septula and two pairs of large, lateral septulae are present.

*Measurements.*—Opesia $\left\{\begin{array}{l} ho=0.20 \text{ mm.} \\ lo=0.14 \text{ mm.} \end{array}\right.$ Zooecia $\left\{\begin{array}{l} Lz=0.22\text{–}0.26 \text{ mm.} \\ lz=0.24\text{–}0.26 \text{ mm.} \end{array}\right.$

*Affinities and variations.*—As we have not observed a polypidian convexity or an opesiule, we can not affirm that this species should be classed in the Coilostega; but on account of its resemblance to *Lunularia distans* Lonsdale 1845, we must provisionally place it in the same vicinity. It differs from *L. distans*, however, in its solid and not hollow zoarium and its smaller zooecia.

From *Lunularia vicksburgensis* Conrad it may be distinguished by the arrangement of its vibracula in all the interzooecial angles.

Its closest affinities are with *Lunularia ligulata* from which it differs in its larger zooecial dimensions and its hydrostatic zooecia, which are always perforated by four rectangular pores which are really opesiules.

We have seen some zoaria without hydrostatic zooecia.

*Occurrence.*—Lower Jacksonian (Moodys marl): Jackson, Mississippi (common).

*Plesiotype.*—Cat. No. 63994, U.S.N.M.

### LUNULARIA TUBIFERA, new species.

Plate 37, figs. 14–18.

*Description.*—The zoarium is a Lunulites, small, irregular, little convex, without fibrous base. The zooecia are hexagonal, somewhat elongated; the mural rim is scarcely distinct from the cryptocyst, which is quite shallow. The opesium is oval, very finely crenulated. The ancestrular zooecia are ordinary zooecia transformed into radicular zooecia by total regeneration. The vibracula are small, symmetrical, without lateral condyles, embedded deeply when they are in distinct rows. On the inner side the zooecia are visible as hollow *tubes*, salient, closed or wide open.

*Variations.*—Toward the center of the zoarium the vibracula are not in distinct rows. They are scattered among the zooecia and are very large (fig. 15).

The hydrostatic zooecia are radicular (fig. 15). We have observed (fig. 16) that the ordinary zooecia may be transformed in radicular zooecia by total regeneration. These zooecial transformations through regeneration according to the necessities of the zoarial life, demonstrate the vital unity of the zoarium and the importance of its special hydrostatic system.

On the inner face only the hydrostatic zooecia appear to be tubiferous. We can not explain the reason for this absence of the basal zooecial wall. Evidently the ectocyst covers all of the zoarium, but must be extremely fragile (fig. 18).

*Affinities.*—*Lunularia tubifera* is close to *L. ovata*, but differs from it in its ancestrular zooecia, which are radicular, and in the complete absence of ribs on the inner face.

*Occurrence.*—Middle Jacksonian: One-half mile southeast of Georgia Kaolin Company mine, Twiggs County, Georgia (rare).

*Cotypes.*—Cat. No. 63995, U.S.N.M.

### LUNULARIA DISTANS Lonsdale, 1845.

Plate 38, figs. 1–20.

1845. *Lunulites distans* LONSDALE, Account of twenty-six species of Polyparia obtained from the Eocene Tertiary formation of North America, Quarterly Journal Geological Society London, vol. 1, p. 531, fig.

1862. *Lunulites distans* GABB and HORN, Monograph of the Fossil Polyzoa of the Secondary and Tertiary formations of North America, Journal Academy Natural Sciences, Philadelphia, ser. 2, vol. 5, p. 119.

1890. *Lunulites distans* DEGREGORIO, Monographie de la Faune Eocenique de l'Alabama et surtout de celle de Claiborne de l'Etage parisien, Annales de Geologie et de Paleontologie, Livraisons 7, 8, p. 250, pl. 42, fig. 29.

1858. *Lunulites contigua* EMMONS, Geological Survey North Carolina, Paleontology, p. 311, figs. 250, 251 (not *L. contigua* Lonsdale, 1845).

*Description.*—The zoarium is a large, convex Lunulites, on which the rows of zooecia alternate with rows of vibracula. The zooecia are disposed in radial and circular rows, and are distinct, elongate, hexagonal, or ogival. The cryptocyst is not distinct from the mural rim; it is deep, flat, very finely granulated; more developed in the small than in the large zooecia; the opesium is elongate, ogival, with a slightly concave proximal border. The ovicell reposes on the distal wall; it is a small convexity, distinct from the mural rim. The vibraculum is elongated, narrow, lozenge-shaped, symmetrical, provided with two lateral condyles. The interior of the zoarium is hollow; the zooecia are devoid of basal walls and are wide open into the zoarial cavity. The inner side is a thin calcareous or chitinous pellicule provided in the interior with numerous tuberosities. The ancestrula is a zooecium identical with the others. The ancestrular zooecia are sometimes hydrostatic or radicular.

*Variations.*—The zoarium generally is of large dimensions (figs. 3, 4, 5). To insure the upright position it is necessary to have an extensive hydrostatic system, because lime is much heavier than the water. This is the reason for the absence of all fibrous tissue.

This exceedingly light apparatus is very fragile and breaks very easily, for entire zoaria are never found. In calcareous sediments the mud fills up the internal cavity and preserves the fragile lamella which covers the zoarium. On these rather common fossils. it may be noted that the inner side (fig. 18) of this lamella bears numerous tuberosities. The radial rows of zooecia are separated by vertical partitions supporting the frontal cryptocyst which has been worn away on account of its fragility, although it is easy to reconstruct it in the mind's eye (figs. 1–5).

The inner side of the zoarium is extremely fragile. Upon the supposition that one of our specimens is a mold of the exterior, an impression of it in wax (fig. 19) gives the external aspect of the inner side, but we have no confirmation of this structure from actual specimens. Quite frequently the zoaria are found with a large cavity representing the place where some incrusting bryozoan or other organism has strengthened the fragile inner side.

We have found some zooecia with a polypidian convexity (fig. 7); the parietal muscles are therefore attached to the cryptocyst.

The size of the zooecia is quite variable and must depend on the size of the ancestrula and the convexity of the zoarium. Figure 11 illustrates the rare case of a gigantic ancestrula surrounded by large zooecia; generally the zoarium commences with radicular zooecia (fig. 8), a zone of small zooecia appears next (figs.

14, 20), and finally the normal zooecia are developed (figs. 7, 9, 10, 12). The zone of small zooecia does not always develop (fig. 11), but fragments containing the two sorts of zooecia are very common.

The endozooecial ovicell is clearly apparent on the splendidly preserved specimen shown in figure 9. Generally it has the more voluminous aspect shown in figures 7 and 10.

In the interior the fragile partitions limit the radial rows of zooecia (fig. 15), and the opesium and the cryptocyst have the same form. The zooecia have no basal wall (fig. 16); the very oblique and much-developed distal wall has an ovicell (*ov.*, fig. 16). Certainly chitinous walls must have taken the place of the usual calcareous walls here absent in order to limit the general cavity which contains leucocytes, ovula, spermatozoa, and the polypide, and separates it from the large partitioned zoarial cavity which can only contain sea water.

The vibracula are as large as the zooecia; they are present in all the interzooecial angles, whereas in *Lunularia vicksburgensis* and in *L. contigua* there is in one row only one vibraculum to two zooecia.

The same large, partitioned zooecial cavity exists also in *Lunularia contigua;* but the latter species has smaller zooecia and is provided with a complete basal wall.

*Occurrence.*—Middle Jacksonian: Wilmington, North Carolina (common), Lonsdale's type locality; near Lenuds Ferry, South Carolina (common); Eutaw Springs, South Carolina (common); 18 miles west of Wrightsville, Georgia (common); 3½ miles north of Grovania, Georgia (rare).

Upper Jacksonian (Ocala limestone): West bank of the Sepulga River, Escambia County, Alabama (rare).

Jacksonian (Zeuglodon zone): Bluff south side of Suck Creek, Clarke County, Mississippi (rare); Cocoa post office, Choctaw County, Alabama (rare).

Vicksburgian (Marianna limestone): One mile north of Monroeville, Alabama (rare); west bank of Conecuh River, Escambia County, Alabama (rare).

*Plesiotypes.*—Cat. Nos. 63997, 63998, U.S.N.M.

### LUNULARIA CONTIGUA Lonsdale, 1845.

Plate 39, figs. 1–5.

1845. *Lunulites contigua* LONSDALE, Account of twenty-six species of Polyparia obtained from the Eocene Tertiary formations of North America, Quarterly Journal Geological Society of London, vol. 1, p. 533, fig. (not Emmons 1858=*L. distans* Lonsdale, 1845).

*Description.*—The zoarium is a large conical Lunulites in which the zooecia and avicularia are disposed in distinct rows. The small zooecia are ogival, little distinct, transverse. The cryptocyst is of little depth and is as long as the opesium; the opesium is semilunar with a nearly straight proximal border. The large zooecia have no cryptocyst. Each zooecium has the form of an isolated, closed sac, situated in a large, partitioned zoarial cavity. The vibracula are long and narrow, with two lateral, improminent condyles, disposed in special rows, but with two to every two zooecia. The inner side is chitinous or very little calcified and bears small tuberosities.

*Measurements:*

Opesium of small zooecia $\left\{\begin{array}{l} ho=0.15 \text{ mm.} \\ lo=0.17 \text{ mm.} \end{array}\right.$ Opesium of large zooecia $\left\{\begin{array}{l} ho=0.30 \text{ mm.} \\ lo=0.26 \text{ mm.} \end{array}\right.$

Small zooecia $\left\{\begin{array}{l} Lz=0.35 \text{ mm.} \\ lz=0.34\text{–}0.40 \text{ mm.} \end{array}\right.$ Large zooecia $\left\{\begin{array}{l} Lz=0.40 \text{ mm.} \\ lz=0.50 \text{ mm.} \end{array}\right.$

*Variations.*—The zoarial organization of this species is analogous to that of *Lunulites distans* Lonsdale, 1845, with this difference, however, that the zooecia are quite calcified on their basal side (fig. 4). The concave molds (figs. 2. 4) show this remarkable character very well. The convex casts which have lost the frontal wall of the zooecia (fig. 1) show the internal side of the inner face of the zoarium; the rows between the partitions are ornamented with numerous tuberosities, in which character the species does not differ from *L. distans* Lonsdale.

Another characteristic of this species is its zooecial dimorphism, which is unique in this genus. We are ignorant of the function of the large zooecium.

Vibracula are not placed in all of the interzooecial angles, as in most of the species of *Lunularia;* there is only one for two zooecia in this way—namely, that the circular rows with vibracula alternate with circular rows without vibracula. Gabb and Horn have proposed the genus *Oligotresium* for this special character. We can not believe that the simple elongation of the small distal canal in which the vibraculum may be lodged is a sufficient generic character.

*Lunularia vicksburgensis* Conrad 1847, presents the same arrangement of the vibracula, but *L. contigua* differs in its zooecial dimorphism.

*Occurrence.*—Middle Jacksonian (Castle Hayne limestone): Wilmington, North Carolina (rare).

*Plesiotypes.*—Cat. No. 63999, U.S.N.M.

### LUNULARIA (OLIGOTRESIUM) CLAIBORNICA, new species.

Plate 13, figs. 13–15.

*Description.*—The zoarium is a convex, expanded Lunulites, formed of radial rows of zooecia and vibracula. The zooecia are ogival, transverse, distinct; the mural rim is very thick; the cryptocyst is small, finely granular. The opesium is semilunar and surrounded by a small collar; the proximal border is a little concave or convex. The ovicell is a distal convexity often covered by the external calcification. The vibracula are elongated, elliptical, disposed in radial rows in the interzooecial angle for two zooecia; joined between them by a small canal; its opesium is narrowed in the lower part by a calcareous lamella, which ends in two condyles. On the inner side the radial rows are convex and pierced by large closely arranged pores.

*Measurements.*—Opesium $\left\{\begin{array}{l} ho=0.17 \text{ mm.} \\ lo=0.16 \text{ mm.} \end{array}\right.$ Zooecium $\left\{\begin{array}{l} Lz=0.30 \text{ mm.} \\ lz=0.40 \text{ mm.} \end{array}\right.$

Vibraculum $\left\{\begin{array}{l} Lv=0.30 \text{ mm.} \\ lv=0.18 \text{ mm.} \end{array}\right.$

*Affinities.*—The vibracula are arranged two to every two zooecia (*Oligotresium* of Gabb and Horn) in which feature the species agrees with *Lunularia contigua* Lonsdale, 1845, and *L. vicksburgensis* Conrad, 1847.

It differs from *Lunularia contigua* in its solid zoarium without hydrostatic zoarial cavity (fig. 13).

It may be distinguished from *Lunularia vicksburgensis* Conrad, 1847, by its vibracular condyles which are without depressions, by its opesial, proximal border which is often convex, by the pores of the rows on the inner face which are much more numerous and closer together, and by its smaller zooecial dimensions.

*Occurrence.*—Claibornian (Gosport sand): One mile southwest of Rockville, Clarke County, Alabama (common); Gopher Hill, Tombigbee River, Alabama (common); Claiborne, Alabama (rare).

*Cotypes.*—Cat. No. 63847, U.S.N.M.

### LUNULARIA (OLIGOTRESIUM) VICKSBURGENSIS Conrad, 1847.

Plate 83, figs. 1–11.

1847. *Lunulites vicksburgensis* CONRAD, Observations on the Eocene formation, and descriptions of one hundred and five new fossils of that period, from the vicinity of Vicksburg, Mississippi, with an appendix, Proceedings Academy Natural Sciences Philadelphia, vol. 3, p. 296; idem 1848, Journal Academy Natural Sciences Philadelphia, ser. 2, vol. 1, p. 127.

1862. *Oligotresium vicksburgensis* GABB and HORN, Monograph of the fossil polyzoa of the Secondary and Tertiary formations of North America, Journal Academy Natural Sciences Philadelphia, ser. 2, vol. 5, p. 139, pl. 19, fig. 22.

*Description.*—The zoarium is a convex expanded Lunulites, without hydrostatic zooecia. The zooecia are distinct, ogival, somewhat transverse; the mural rim is very thick; the cryptocyst is very small and finely granulated. The opesium is oval, narrowest at the top, the proximal border quite concave; it is bordered by a small collar. The ovicell is a distal convexity hidden by the external calcification. The vibraculum is very long; its opesium is large and narrowed in the upper third by two large condyles with a small fossette. The vibracula are arranged in radial rows, but there is only one to every two interzooecial angles. On the inner side the radial lines are convex and garnished with large scattered pores. One pair of lateral septulae.

*Measurements.*—Opesium $\left\{\begin{array}{l} ho=0.20 \text{ mm.} \\ lo=0.20\text{–}0.25 \text{ mm.} \end{array}\right.$ Marginal zooecium $\left\{\begin{array}{l} Lz=0.35 \text{ mm.} \\ lz=0.35 \text{ mm.} \end{array}\right.$

Vibraculum $\left\{\begin{array}{l} Lv=0.35 \text{ mm.} \\ lv=0.20 \text{ mm.} \end{array}\right.$

*Variations.*—The micrometric dimensions of the zooecia and opesia are quite variable and are notably larger on the zoarial margins. The ectocyst which floats in the hypostege secretes a thin calcareous granular layer which is deposited chiefly on the primitive olocyst of the cryptocyst and ovicell (fig. 2).

The vibraculum is not always elliptical; it has sometimes a distal callosity in the form of the leaf of *Sagittaria* (fig. 3).

As usual in the genus, there is a pair of large, lateral septulae (fig. 7) and a large, distal septula (fig. 10).

Growth is accomplished by segments irradiating from the center or from a bifurcation (figs. 8, 9); this is, moreover, very irregular (fig. 5). The segments are inserted the one into the other (fig. 10).

The small interzooecial canals are very close together (fig. 7).

The ancestrula is a hydrostatic and radicular zooecium (fig. 4); indeed only the larva is attached to large objects (fig. 9). There are no other hydrostatic zooecia.

The pores of the inner face are at the extremity of the tubules which perforate the test even to the zooecia.

*Affinities.*—This species differs from *Lunularia claiborniea* in its larger micrometric dimensions, its shallow pit in each vibracular condyle, and in its proximal, opesial border, which is quite concave and never convex.

It differs from *L. contigua* which has the same arrangement of vibracula, in the complete absence of the entire zoarial cavity.

All the other Lunulites forms observed have their vibracula placed in all the interzooecial angles and therefore can not be confounded.

As noted before, Gabb and Horn have created the genus *Oligotresium* because of this especial disposition of the vibraculum; but we do not believe it necessary to adopt this genus.

*Occurrence.*—Vicksburgian (Byram marl): Vicksburg, Mississippi (rare); ¼ mile west of Woodward, Wayne County, Mississippi (common); Byram, Mississippi (common).

Vicksburgian (Red Bluff clay): Red Bluff, Wayne County, Mississippi (rare).

*Plesiotypes.*—Cat. No. 64255, U.S.N.M.

### LUNULARIA JACKSONENSIS, new species.

Plate 37, figs. 19–22.

*Description.*—The zoarium is a somewhat convex Lunulites. The zooecia are distinct, rectangular, disposed in radial and circular rows; the mural rim is salient. The cryptocyst is smooth, sunken, little developed; the opesium is large, oval, enlarged at the base. The vibracula are placed in distinct radial rows in all of the interzooecial angles; they are symmetrical and bear two lateral condyles. The hydrostatic zooecia are numerous, closed by an irregular, nonperforated olocyst. The inner side bears large, radial tuberose costules.

*Measurements.*—Opesia $\begin{cases} ho=0.22 \text{ mm.} \\ lo=0.20 \text{ mm.} \end{cases}$ Zooecia $\begin{matrix} Lz=0.35 \text{ mm.} \\ lz=0.35 \text{ mm.} \end{matrix}$

*Affinities.*—In the form of its zooecia this species is close to *Lunulites fenestrata* Gregorio 1890; it differs from it in the inner face, which is tuberculose and nonperforated.

It differs from *Lunularia tintinabula* in its flatter zoarium and in its inner side, which is tuberose and not perforated.

It differs from *Lunularia ovata* in its much larger zooecial dimensions.

This species has only been found in the single locality at Jackson, where it appears abundant in association with *Lunularia fenestrata* De Gregorio 1890.

*Occurrence.*—Lower Jacksonian (Moodys marl): Jackson, Mississippi (common).

*Cotypes.*—Cat. No. 63996, U.S.N.M.

### LUNULARIA TINTINABULA, new species.

Plate 83, figs. 12–16.

*Description.*—The zoarium is a Lunulites in the form of a little *bell* with hydrostatic zooecia. The zooecia are distinct, elongated, ogival; the mural rim is thin; the cryptocyst is quite concave, smooth, much shorter than the opesium. The opesium is oval, elongated, largely surrounded by a salient peristome. The vibracula are arranged in radial rows; they are symmetrical, oval; their opesium is narrowed laterally by two teeth; the anterior portion is much larger than the inferior portion. The hydrostatic zooecia bear a prominent thread, distal semilunar. On the inner side the radial rows are quite convex and garnished with large scattered pores. The zoarial surface is pelliculoid.

*Measurements.*—Opesium $\begin{cases} ho=0.25 \text{ mm.} \\ lo=0.15 \text{ mm.} \end{cases}$ Vibracula $\begin{cases} Lv=0.30 \text{ mm.} \\ lv=0.12 \text{ mm.} \end{cases}$

Marginal zooecia $\begin{cases} Lz=0.35\text{–}0.40 \text{ mm.} \\ lz=0.25\text{–}0.30 \text{ mm.} \end{cases}$

*Variations.*—The exterior surface of the zooecia is very fragile; it is easily detached. The zooecia then appear under another aspect. There is no cryptocyst; the peristome of the opesium does not exist. There are no condyles to the vibracula. These two aspects are quite visible on figure 14. An analogous phenomenon has been observed on *Lunularia conica* Busk, 1859, as Canu has noted it in 1916.

Only the distal half of the opesial peristome exists on the hydrostatic zooecia. This is a very important character, but it is not constant. It is sometimes replaced by a furrow of the same form and limiting a long tongue as in *Lunularia ligulata* (fig. 15).

*Affinities.*—This species differs from *Lunularia ligulata* and from *Lunularia fenestrata* in which the opesium is also bordered by a peristome in its much larger micrometric dimensions ($Lz=0.35$ mm. instead of 0.20 mm.).

In its exterior aspect it much resembles *Lunularia jacksonensis;* it differs from it in its much more conical zoarium, in its hydrostatic zooecia provided with a semi-elliptical, distal thread, and in its inner side which is porous and not tuberous.

It differs from *Lunularia vicksburgensis* Conrad, 1847, in the disposition of its vibracula placed in all the interzooecial angles; it is this feature which does not permit it to be classified in the *Oligotresium* group.

*Occurrence.*—Vicksburgian (Byram marl): One-fourth mile west of Woodward, Wayne County, Mississippi (very common).

Vicksburgian (Marianna limestone): Vicksburg, Mississippi (rare in the lower beds).

Vicksburgian (Red Bluff clay): Red Bluff, Wayne County, Mississippi (rare).

*Cotypes.*—Cat. No. 64256, U.S.N.M.

### KEY TO SPECIES OF LUNULARIA.

| | | |
|---|---|---|
| 1 | Vibracula in all the interzooecial angles | 4 |
| | Vibracula only in alternate interzooecial angles (Oligostresium) | 2 |
| 2 | Zoarium hollow, zooecia dimorphic | *L. contigua* |
| | Zoarium solid | 3 |
| 3 | Condyles with fossette; large, oval opesium | *L. vicksburgensis* |
| | Condyles without fossette; small semilunar opesia | *L. claibornica* |
| 4 | Zoarium hollow, without ribs on inner face | 5 |
| | Zoarium solid, with ribs on inner face | 6 |
| 5 | Small zooecia (*Lz* 0.25 mm), tubular, no partitions | *L. tubifera* |
| | Large zooecia (*Lz* 0.50, 0.70 mm.), zoarial partitions | *L. distans* |
| 6 | Inner face with perforated ribs | 7 |
| | Ribs of inner face not perforated but tuberose | 8 |
| 7 | Ancestrular zooecia with a partition; bordered opesium | *L. ligulata.* |
| | Ancestrular zooecia with four pores | *L. fenestrata* |
| | Ancestrular zooecia tuberous, cryptocyst larger than the opesium | *L. verrucosa* |
| | Ancestrular zooecia with a semicircular salient thread | *L. tintinabula* |
| 8 | Opesium bordered | *L. jacksonensis* |
| | Opesium not bordered | 9 |
| 9 | Small oval opesium (*ho* 0.15 mm.) | *L. ovata* |
| | Large opesium (*ho* 0.30 mm.) | *L. grandipora* |

## Family ASPIDOSTOMIDAE Canu, 1908.

*Bibliography (Anatomical).*—1886. JULLIEN, Mission Scientifique du Cap Horn, Bryozoaires vol. 6, p. 77.—1889. WATERS, Scientific Results Voyage *Challenger*, Suppl. Rep. 31, p. 28, pl. 1, figs. 16–18; pl. 3, figs. 20, 21.—1905. WATERS, Bryozoa from near Cap Horn, Journal Linnean Society, vol. 29, p. 243 pl. 29, figs. 1–3.—1909. LEVINSEN, Morphological and Systematic Studies Cheilostomatus Bryozoa, p. 171.

The zooecia have a raised margin, often indistinctly or incompletely developed. The two opesiules appear as narrow incisions, which join the zooecial aperture; the short polypide tube, which is not continued under the cryptocyst cover, is in most cases provided with marginal flanges. Avicularia are always present. Ovicells are hyperstomial.

In 1886 Jullien discovered the relationship of *Eschara* (*Aspidostoma*) *gigantea* Busk, 1854, with the Onychocellidae. In 1889 Waters figured the operculum and noted its resemblance to *Rhagasostoma* Koschinsky, 1885. In 1905 he confirmed the fact that the opesiular indentations serve as a passageway for the opercular muscles. He established that in *Rhagasostoma* the operculum is borne by the ectocyst. In 1909 Levinsen thought that the lateral indentations were opesiules and classified the family in the Coilostega tubifer, because he discovered a sort of polypidian tube. Moreover, he discovered in *Crateropora falcata* Levinsen an avicularium analogous to that of *Eschara antiopa* D'Orbigny of the Cretaceous; finally, he noted the resemblances of *Eschara aegon* D'Orbigny and *E. atalantha* D'Orbigny to *Aspidostoma*. Different species were described by Canu in 1904, 1908, and 1911.

The known genera of this family are:—

*Aspidostoma* Hincks, 1881.
*Rhagasostoma* Koschinsky, 1885.
*Euritina* Canu, 1900.
*Odontionella* Canu and Bassler, 1917.
*Foraminella* Levinsen, 1909.
*Crateropora* Levinsen, 1909.
*Labiopora* Levinsen, 1909.

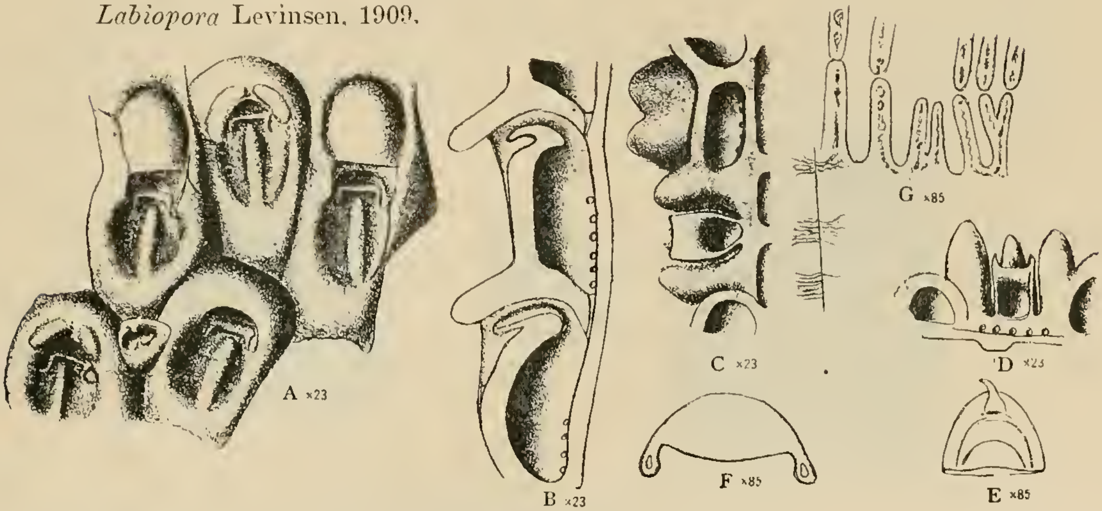


FIG. 65.—Family Aspidostomidae Canu, 1908.

A–G. *Aspidostoma giganteum* Busk, 1884. A. Several zooecia, two of them with ovicells, × 23. B. A longitudinal section through two zooecia, × 23. C. A transverse section through two zooecia, × 23. Uppermost a distal wall is seen and to the left of this the arched distal end of the zooecium. Further down an intersected polypide tube is seen and on each side of this a recess which extends to the basal wall. D. A transverse section through a zooecium, × 23. The median projection of the zooecium is seen beneath the polypide tube. (A–D After Levinsen, 1909.) E. Avicularian mandible, × 85. F. Operculum, × 85. (E, F after Waters, 1888.) G. Distal connections and lateral connections through the septulae, × 85. (After Waters, 1905.)

### Genus RHAGASOSTOMA Koschinsky, 1885.

1885. *Rhagasostoma* KOSCHINSKY, Ein Beitrag zur Kenntnis der Bryozoenfauna der alterer Tertiärschichten Bayerns, Paleontographica, vol. 32, p. 29.

The ovicell is hyperstomial and opens above the opercular valve; it has no lateral expansions (compressed process). The avicularia are interzooecial.

*Genotype.*—*Rhagasostoma hexagonum* Koschinsky, 1885.

*Range.*—Eocene-Miocene.

The definition of this genus, established by Koschinsky in 1885, was extended by Canu in 1900 to all the species provided with opesial incision. The number of the species is now therefore rather large, and it may become convenient perhaps to make some restrictions. The avicularia are quite variable. *Rhagasostoma cingens*, *R. hexagonum*, and *R. circumvallatum* Koschinsky, 1885, from the Lutetian of Bavaria, have falciform onychocellaria. *Rhagasostoma dutempleanum* D'Orbigny, 1852, and *R. pugeti* Canu, 1907, of the Parisian Lutetian, have an avicularium with double orifice. *Rhagasostoma prominens*, Canu, 1907, also from the Parisian Lutetian, possesses an avicularium with two to four false opesiules. Many Cretaceous species of *Rhagasostoma* possess the delicate avicularia called reticulocellaria by Canu.

Such variations exist likewise in *Aspidostoma*. *Aspidostoma giganteum* Busk, 1854, and *A. globiferum* Canu, 1911, have only small frontal or marginal avicularia. The other species have interzooecial avicularia. *Aspidostoma poriferum* Canu, 1904, has an avicularium with lateral teeth, as has also *A. incrustans* Canu, 1908. There is an avicularium with pivot in *Aspidostoma flammulum* Canu, 1908. Finally, *Aspidostoma onychocelliferum* Canu, 1911, has perhaps a real onychocellarium.

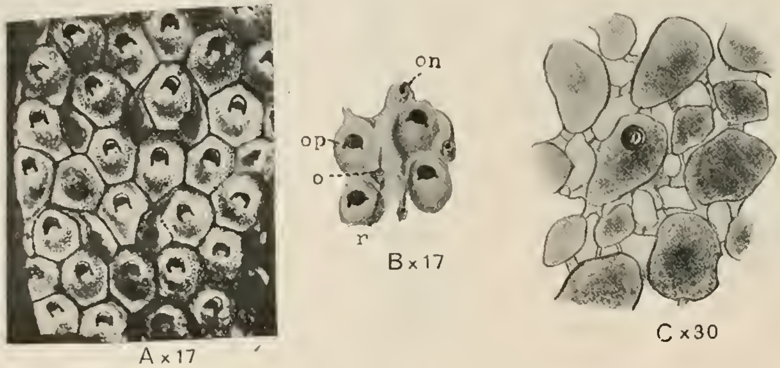


Fig. 66.—Genus *Rhagasostoma* Koschinsky, 1885.

A. *Rhagasostoma hexagonum* Koschinsky, 1885. Zooecia, × 17 (after Koschinsky, 1885). B. C. *Rhagasostoma crassa*, Beissel, 1865. B. Several zooecia and onychocellaria, × 17. *o*, passage of the occlusor muscles of the mandible; *on*, onychocellarium; *op*, opesiule; *r*, passage of the elevator muscles of the mandible.

C. Internal cast, × 30. (B, C after Beissel, 1865.)

*Rhagasostoma* is the *Aspidostoma* of the northern hemisphere. In Europe the genus dies out in the Lutetian. Here, in America, it survives into the Vicksburgian. In Australia it is found in the Miocene.

*Rhagasostoma dutempleanum* D'Orbigny, 1852, and *R. spiniferum* Canu, 1913, appear to form a distinct genus on account of the nature of their ovicells.

### RHAGASOSTOMA LEVIGATUM, new species.

Plate 39, figs. 6, 7.

*Description.*—The zoarium incrusts shells. The zooecia are distinct, elongated, separated by a furrow; the mural rim is complete, salient, a little broader at the base. The cryptocyst is deep, *smooth*, and somewhat convex; the polypidian convexity is improminent and the opesiules somewhat linear. The ovicell is globular, salient, smooth, opening in a large orifice above the opercular valve. The avicularium is interzooecial, smaller than the zooecium, fusiform, terminated by a small but wide canal; its opesium is median and very small.

*Measurements.*—Opesium $\left\{\begin{array}{l} ho=0.10 \text{ mm.} \\ lo=0.15 \text{ mm.} \end{array}\right.$ Avicularium $\left\{\begin{array}{l} Lav=0.40\text{–}0.50 \text{ mm.} \\ lav=0.20 \text{ mm.} \end{array}\right.$

Zooecium (including opesiules) $\left\{\begin{array}{l} Lz=0.55\text{–}0.60 \text{ mm.} \\ lz=0.35\text{–}0.40 \text{ mm.} \end{array}\right.$

*Affinities.*—This species differs from *Aechmella filimargo* in its hyperstomial ovicell. It may be distinguished from *Rhagasostoma minusculum* by its larger dimensions. Specimens from both the Jacksonian and Vicksburgian have been discovered. It appears to us that there were no essential differences between them, so we have united them under the same species.

*Occurrence.*—Middle Jacksonian (Castle Hayne limestone): Wilmington, North Carolina (very rare).

Vicksburgian (Marianna limestone): Salt Mountain, 5 miles south of Jackson, Alabama (very rare).

*Cotypes.*—Cat. Nos. 64000, 64001, U.S.N.M.

### RHAGASOSTOMA MINUSCULUM, new species.

Plate 39, fig. 8.

*Description.*—The zoarium incrusts bryozoa. The zooecia are very *small*, oval, distinct, separated by a furrow; the mural rim is prominent, slightly thickened, enlarged at the base, complete. The cryptocyst is deep, smooth, flat; the polypidian convexity is improminent; the opesiules are rounded incisions. The ovicell is globular and prominent. The avicularium is interzooecial, elongated, fusiform, terminated by a very short but wide canal.

*Measurements.*—Opesium $\left\{\begin{array}{l} ho=0.07 \text{ mm.} \\ lo=0.10 \text{ mm.} \end{array}\right.$ Avicularium $\left\{\begin{array}{l} Lav=0.20 \text{ mm.} \\ lav=0.10 \text{ mm.} \end{array}\right.$

Zooecium (including opesiules) $\left\{\begin{array}{l} Lz=0.30\text{–}0.35 \text{ mm.} \\ lz=0.24\text{–}0.28 \text{ mm.} \end{array}\right.$

*Affinities.*—This is one of the smallest bryozoans known. It is difficult to conceive how such a small structure could contain tentacles, pharynx, stomach, intestines, muscles, and ovaries and lodge a creature much more perfected than an oyster or a Tridacne.

*Occurrence.*—Middle Jacksonian: Wilmington, North Carolina (very rare); Eutaw Springs, South Carolina (very rare).

*Holotype.*—Cat. No. 64002, U.S.N.M.

### Genus ODONTIONELLA Canu and Bassler, 1917.

1917. *Odontionella* CANU and BASSLER, Synopsis American Early Tertiary Cheilostome Bryozoa, Bulletin 96, U. S. National Museum, p. 12.

Ovicell hyperstomial. No condyle for the opercular valve. The opesium is not symmetrical. The proximal border of the opesium bears irregular spinous processes, short, flat, more or less wide. The opesiular indentations are dissymmetrical. The operculum projects beyond the ridge. Sixteen tentacles. The avicularium is placed on the gymnocyst.

*Genotypes.—Odontionella* (*Membranipora*) *hians* Hincks, 1885, and *Odontionella* (*Membranipora*) *occultata* Waters, 1887.

*Range.*—Pliocene–Recent.

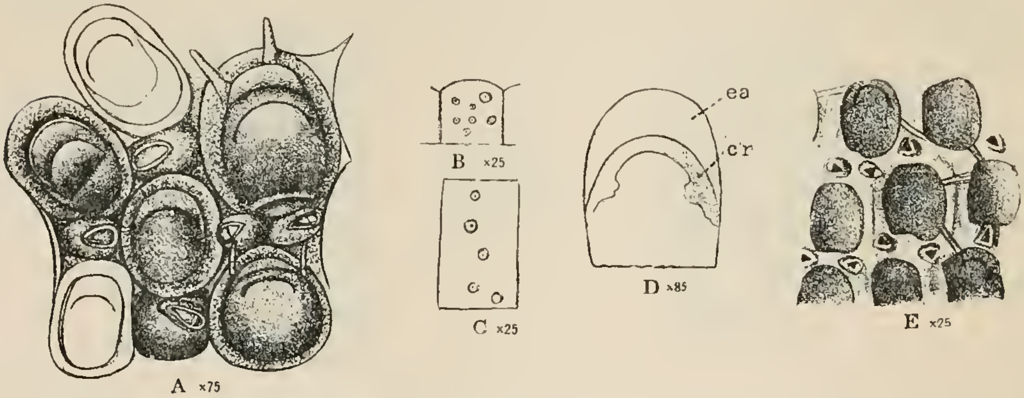


FIG. 67.—Genus *Odontionella* Canu and Bassler, 1917.

A–E. *Odontionella* (*Membranipora*) *hians* Hincks, 1885. A. Zooecia, × 75. (After Hincks, 1885.) B. Distal wall with septulae, × 25. C. Lateral wall with septulae, × 25. D. Operculum, × 85, showing chitinous ridge (*cr*) and expansion (*ea*). E. Zooecia, × 25. (B–E after Waters, 1898.)

In 1917 we included in this genus species of *Acanthodesia*, new genus, but later researches have shown that the type of *Odontionella* has opesiular indentations. The latter genus thus really belongs to the Aspidostomidae Canu, 1908.

### Genus EURITINA Canu, 1900.

1900. *Euritina* CANU, Revision des Bryozoaires du Cretace figurés par d'Orbigny, Bulletin Societe Geologique, France, ser. 3, vol. 28, p. 411.

Ovicell hyperstomial, never closed by the opercular valve; avicularium interzooecial; cryptocyst well developed, with three facets separated by two longitudinal grooves; no dietellae.

*Genotype.—Euritina* (*Eschara*) *eurita* D'Orbigny, 1852.

*Range.*—Turonian—Eocene.

We are ignorant of the physiological function of the lateral grooves of the cryptocyst, but as they are very constant in this group of species, they must be considered. We have studied a number of species with a faceted cryptocyst, notably *Membraniporidra spissimuralis*. It is not certain that the Cretaceous species are provided with onychocellaria, for these structures are perhaps interzooecial avicularia, of a special type now extinct. In the interior the polypidian tube is analogous to that in *Aspidostoma* Hincks, 1881; it is a thickening of the proximal border of the aperture.

The species of the genus are:

*Euritina* (*Eschara*) *curita* D'Orbigny, 1852.
*Euritina welschi* Canu, 1900.
*Euritina lata* Canu, 1911.
*Euritina elongata* Canu, 1911.
*Euritina intermedia* Canu, 1911.
*Euritina* (*Biflustra*) *torta* Gabb and Horn, 1862.
*Euritina* (*Vincularia*) *gracilis* D'Orbigny, 1852.

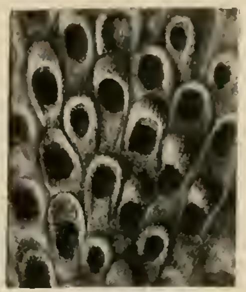


FIG. 68.—Genus *Euritina* Canu, 1900.

*Euritina* (*Eschara*) *eurita* D'Orbigny, 1852. Zooecia, with ovicells, × 20.

### EURITINA TORTA Gabb and Horn, 1862.

Plate 1, fig. 16.

1862. *Biflustra torta* GABB and HORN. Monograph of the Fossil Polyzoa of the Secondary and Tertiary formations of North America, Journal Academy of Natural Sciences, Philadelphia, ser. 2, p. 152, pl. 20, fig. 36.

1901. *Biflustra torta* ULRICH, Maryland Geological Survey, Eocene, p. 214, pl. 60, fig. 7.

1909. *Biflustra torta* WELLER, Cretaceous Faunas, Geological Survey of New Jersey, vol. 4, p. 332.

*Measurements.*—Opesia $\begin{cases} ho = 0.25 \text{ mm.} \\ lo = 0.12\text{–}0.15 \text{ mm.} \end{cases}$ Zooecia $\begin{cases} Lz = 0.40\text{–}0.45 \text{ mm.} \\ lz = 0.25\text{–}0.30 \text{ mm.} \end{cases}$

The zoarium is bilamellar; the two lamellae are back to back and may be separated. The cryptocyst is deep and the two grooves which separate it from the mural rim are quite visible.

The onychocellarium is straight, symmetrical, oval; the beak is salient in front of the zooecial plane; there is no pivot.

At the base of our figure there is a regenerated zooecium.

"Although rather variable this is still to be counted as an easily recognized species. Ovicells occur but rarely, only four or five specimens out of fifty or more in my collection having any at all. They are cucullate often with a delicate longitudinal ridge across them and uniformly convex." (Ulrich, 1901.)

*Occurrence.*—Lowest Eocene (Bryozoan bed at base of Aquia formation): Upper Marlboro, Maryland (rare).

*Geological distribution.*—Upper Cretaceous (Vincentown limesand): Mullica Hill, Timber Creek, and Vincentown, New Jersey.

*Plesiotype.*—Cat. No. 63778, U.S.N.M.

### EURITINA TECTA, new species.

Plate 5, figs. 1–7.

*Description.*—The zoarium is free and bilamellate. The zooecia are distinct, very elongate, vaguely oval; the mural rim is thin, thickened laterally, and forms the two lateral facets of the cryptocyst. The cryptocyst is smooth, flat, oblique toward the opesium. The opesium is elongate entire, elliptical, or it may have a proximal border more or less straight. The ovicell is hyperstomial, never closed by the opercular valve, globular, salient, smooth. The primoserial zooecia have special avicularia without pivot, marked with a distal convexity protruding much above the zooecial plane.

$$\textit{Measurements.}\text{—Opesia}\left\{\begin{array}{l} ho=0.22\text{ mm.}\\ lo=0.12\text{ mm.}\end{array}\right.$$

$$\text{Zooecia}\left\{\begin{array}{l} Lz=0.45\text{–}0.50\text{ mm.}\\ lz=0.25\text{ mm.}\end{array}\right.$$

*Variations.*—The lateral grooves are very constant on the bilamellar zoaria, but on specimens which contain supplementary lamellae, the zooecia are devoid of them and appear to belong to another species (fig. 1). The cryptocyst and the mural rim are formed of very large but very compact olocystal elements (fig. 3). They are a little oriented on the mural rim according to the general rule. The cryptocyst is often divided into two symmetrical parts by a longitudinal linear junction (fig. 3). The bottom of the zooecia is the ordinary olocyst (fig. 4). The interior of the zooecia (figs. 5, 6, 7) does not correspond at all to the exterior. There is no trace of the grooves in the cryptocyst, and the lower opesial border is much thickened as in *Aspidostoma* Hincks, 1881.

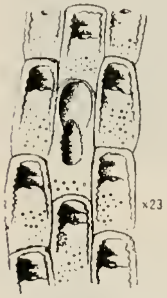


Fig. 69.—Genus *Labiopora* Levinsen, 1909. *Labiopora crenulata* Levinsen, 1909. Zooecia, × 23 (After Levinsen, 1909).

The primoserial zooecia, quite different in form at the surface, have in the interior a shape exactly identical with the other zooecia, although plainly narrower. The exterior distal convexity of these zooecia is very constant and reminds one somewhat of a little roof. Figure 2 shows a regenerated zooecium of quite unusual character. Here a normal zooecium succeeds a "calcified" one.

*Occurrence.*—Midwayan (Clayton limestone): One mile west of Fort Gaines, Georgia (common); Mabelvale, near Little Rock, Arkansas (common).

*Cotypes.*—Cat. No. 63807, U.S.N.M.

### Genus LABIOPORA Levinsen, 1909.

1909. *Labiopora* Levinsen, Morphological and systematic studies on the Cheilostomatous Bryozoa, p. 171.

No oviccll; distinct raised margins; frontal wall of polypide-tube not quadrangular and not surrounded by projecting flanges. Polypide-tube bilabiate, on either side connected with the lateral wall by a vertical calcareous lamina; multiporous septulae.

*Genotype.—Labiopora crenulata* Levinsen, 1909.

### Genus CRATEROPORA Levinsen, 1909.

1909. *Crateropora* Levinsen, Morphological and systematic studies on the Cheilostomatous Bryozoa, p. 171.

No ovicell; distinct raised margins; frontal wall of polypide-tube not quadrangular and not surrounded by projecting flanges. Polypide-tube not bilabiate, with an expanded distal margin, not connected with the lateral walls by vertical calcareous laminae; uniporous septulae. (Levinsen, 1909.)

*Genotype.—Crateropora falcata* Levinsen, 1909.

*Aspidostoma flammulum* Canu, 1908, of the Patagonian of Argentina may perhaps belong to this genus, although it bears ovicells.

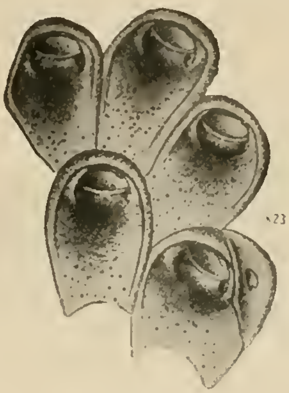


Fig. 70.—Genus *Crateropora* Levinsen, 1909.

*Crateropora falcata* Levinsen, 1909. Zooecia, ×23. (After Levinsen, 1909).

## Family STEGANOPORELLIDAE Levinsen, 1909.

*Bibliography (Anatomical).*—1900. Harmer, A revision of the genus Steganoporella, Quarterly Journal Microscopical Science, vol. 43, pp. 225–295, pl. 12, 13.—1902. Harmer, On the Morphology of the Cheilostomata, Quarterly Journal of Microscopical Science, p. 317, pl. 18, figs. 64, 65, 66.—1909. Levinsen, Morphological and systematic studies on the Cheilostomatous Bryozoa, p. 167, pl. 6, figs. 2–7.—1913. Waters, Bryozoa from Zanzibar, Proceedings of the Zoological Society of London, p. 498, pl. 72, figs. 12–20.

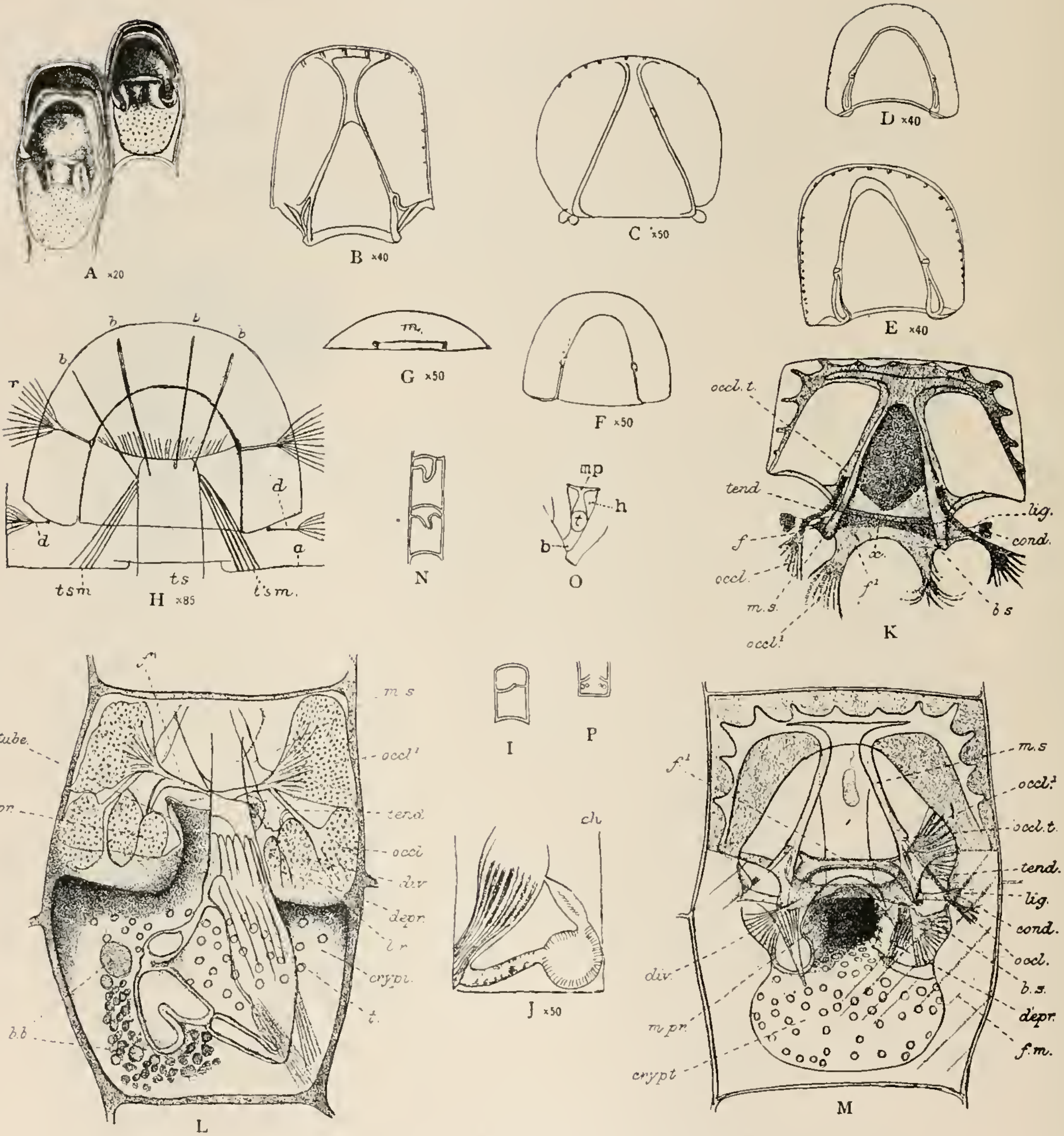
The zooecium is divided into two chambers. The proximal chamber contains the polypide and the ovaries; it is terminated by an ascending tube, the polypide tube, in which the tentacles are lodged when the polypide is retracted. The upper chamber contains the parietal and opercular muscles. The retractor muscles of the polypide are attached in one of the lower angles of the zooecium, which causes the general assymetry of the zooecium. No ovicells, no avicularia. Generally two forms of zooecia: *a* and *B*. The two opesiules are generally not separated from the aperture of the zooecium. The operculum, which is sometimes bounded by a chitinous sclerite proximally, sometimes continued immediately into the frontal membrane, is, as a rule, very large, and then suspended by strong hinge-teeth.

The structure in this family is remarkable and of great interest. The figures that are reproduced permit the reader to easily comprehend its details, despite the complexity of the terminology. The two known genera are *Steganoporella* Smitt, 1873, and *Siphonoporella* Hincks, 1880.

### Genus STEGANOPORELLA Smitt, 1873.

1873. *Steganoporella* Smitt, Floridan Bryozoa, Kongl. Svenska Vetinskaps-Akademiens Handlingar, vol. 11, No. 4, p. 15.

The whole of the calcified part of the frontal area lying proximally to the aperture is a depressed cryptocyst; the aperture of the zooecium is surrounded


A ×20
B ×40
C ×50
D ×40
E ×40
G ×50
m.
F ×50
b
b
b
b
r
d
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a
tsm
ts
t'sm.
H ×85
N
mp
h
t
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f
x
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f¹
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b s
occl¹.
K
f
m s
tube.
occl¹
depr.
tend.
occl.
div.
depr.
l.r.
crypt.
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crypt
M

FIG. 71.—Family Steganoporellidae Levinsen, 1909.

Fig. 71.—Family Steganoporellidae Levinsen, 1909.

A–H. *Steganoporella magnilabris* Busk 1852. A. View showing the *a* and *B* zooecia, × 20. B, C. Operculum of *B* zooecium; × 40 and × 50. D, E. Opercula of *a* zooecia; × 40. F. Operculum of *a* zooecia; × 50. G. Section cut through an operculum showing a membrane (*m*) between the main sclerites, × 50. H. Operculum, × 85. Decalcified distal end seen from inside with the basal wall removed. The tentacular sheath (*ts*) is held by four bands (*b*) attached to the distal wall; also there are muscles (*tsm*) from the distal end of the tentacular sheath to the wall (*a*) which divides the zooecium. The large retractor muscles (*r*) are seen attached to a tendon, while below there is a smaller pair of muscles (*d*) not attached direct to the operculum, but to the frontal wall quite close to the operculum.

I. Back of zooecium.

J. View, × 50, showing the tentacular parts attached to the side wall of the proximal corner, while the stomach, etc., is in the other corner connected by a long, narrow esophageal tube. (A, B, D, E, I after Harmer, 1900; C, F, H, J after Waters, 1915.)

K–M. *Steganoporella alveolata* Harmer, 1900. K. *B* operculum with its occlusor muscles, seen from the inner side, and somewhat distally so as to be considerably foreshortened; *cond*, condyles, united to the basal sclerite (*bs*) of the operculum by the strong ligaments *lig*; *occl*, proximal occlusor muscle, the tendon (*tend*) of which is inserted into the occlusor tubercle (*occl, t.*) of the operculum and gives off a fascia (*f*) which connects it with the projecting proximal end of the main sclerite (*ms*); *occl'* distal occlusor, inserted into the fascia *f'*, *x*, line along which the operculum passes into the roof of the vestibule.

L. Basal view of a *B* zooecium (basal wall removed). The cryptocyst (*crypt*) is seen from its basal surface; part of the floor of the lateral recesses (*lr*) is broken away. Between the two recesses is the passage (*tube*) by which the tentacle sheath passes to the orifice; *occl'*, distal occlusors, with their transverse facia (*f'*); *occl*, proximal occlusor with its tendon (*tend*); *depr*, depressor muscles of frontal membrane; *div*, divaricator muscles of operculum; *ms*, main sclerite of operculum. The movements of the tentacle sheath are restrained by four delicate muscles, two of which originate from the wall of the tube.

M. Frontal view of a *B* zooecium; *occl. t.*, occlusor tubercle; *lig*, hinge-ligaments, connecting the condyles (*cond*) with the ends of the basal sclerite (*bs*); *fm*, frontal membrane, into which the depressor muscles (*depr*) are inserted; *mpr*, median process, arising from the roof of the tube; other letters as in fig. O. (K–M after Harmer, 1902.)

N. *Steganoporella lateralis* MacGillivray, 1895. Back of zooecium.

O. *Steganoporella neozolanica* Busk, 1861. Typical form. Part of transverse section of the colony seen from the distal side; *b*, basal wall; *h*, vertical proximal wall of one of the lateral recesses; *mp*, distal wall of the flask-shaped cavity of the median process; *t*, opening into the subopercular cavity of the zooecium.

P. *Steganoporella buskii* Harmer, 1900. Proximal wall of a zooecium showing the insertion of the cryptocyst and the two fragmented septulae. (N–P after Harmer, 1900.)

distally and laterally by a projecting margin; the zooecia frequently, occurring in two forms *a* and *B* and provided with a large operculum armed with teeth, which is suspended by strong hinge-teeth; the polypide-tube is never continued proximally beneath the cryptocyst cover. (After Levinsen, 1909.) 25 tentacles.

*Genotype.*—*Steganoporella* (*Membranipora*) *magnilabris* Hincks, 1881.

*Range.*—Lutetian-Recent.

The known fossil species of this genus are:

*Steganoporella* (*Gaudryanella*) *asymetrica* Canu, 1907, Lutetian of the Paris Basin.

*Steganoporella* (*Gargantua*) *firma* Canu, 1907, not Reuss, Lutetian of the Paris Basin.

*Steganoporella similis* Koschincky, 1885, Lutetian of Bavaria.

*Steganoporella* (*Vincularia*) *haidingeri* Reuss, 1869, Priabonian of the Vicentin.

*Steganoporella* (*Lepralia*) *firma* Reuss, 1867, Priabonian of the Vicentin.

*Steganoporella* (*Eschara*) *elegans* Milne-Edwards, 1838, Aquitanian-Helvetian of France.

*Steganoporella elegans* Smitt, 1873 (not Milne-Edwards, 1838), still lives off the coast of Florida at a depth of 15–37 fathoms.

### STEGANOPORELLA JACKSONICA, new species.

Plate 39, figs. 9–16.

*Description.*—The zoarium is bilamellar formed of two layers back to back and easily parted. The *a* zooecia are very elongated, narrow, distinct; the mural rim is thin, salient; the cryptocyst is deep, granular, and porous; the opesium is semilunar and transverse; there is no polypide-tube, but a small polypidian convexity is present; the two opesiules are small, rounded, lateral incisions, quite indistinct; the inner partition is very oblique. The *B* zooecia are twice as large, ogival, larger at the top than at the bottom; their polypide-tube is salient and complete; the two opesiules are two deep, rounded incisions; the opesium is bordered by a double collar (oral arch); the distal niche is large, smooth, deep; the *B* zooecia always engender two new rows of *a* zooecia.

*Measurements.*—*a* zooecia $\begin{cases} Lz=0.46\text{–}0.50 \text{ mm.} \\ lz=0.24 \text{ mm.} \end{cases}$ Opesium $\begin{cases} ho=0.12 \text{ mm.} \\ lo=0.16\text{–}0.20 \text{ mm.} \end{cases}$

*B* zooecia $\begin{cases} Lz=1.20 \text{ mm.} \\ lz=0.50 \text{ mm.} \end{cases}$

*Variations.*—It is rather remarkable that if the *a* zooecia become enlarged the *B* zooecia are shorter.

The frontal is a direct tremocyst (fig. 14) in which the granulations of the cryptocyst often fill up the perforations.

Only the *B* zooecia have a distinct polypide tube (figs. 10, 16). After wearing away the frontal the *a* zooecia are seen to have an oblique partition more elevated at the top than at the base (fig. 13). Similar abrasion on the dorsal side permits (fig. 12) one to ascertain how the polypide may project between the partition and the opesial collar.

*Affinities.*—The $a$ zooecia are much narrower than in *Steganoporella rectangularia* ($lz$=0.24 mm. instead of 0.36 mm.).

*Steganoporella jacksonica* differs from *Steganoporella incrustans* in its bilamellar zoarium and its perforated cryptocyst.

It differs from *Steganoporella vicksburgica* in its much smaller micrometric dimensions. The widespread occurrence of this species in the Jacksonian has occasioned its specific name.

*Occurrence.*—Lower Jacksonian: Jackson, Mississippi (rare).

Middle Jacksonian: Baldock, Barnwell County, South Carolina (very abundant); 18 miles west of Wrightsville, Georgia (rare); 3¼ miles south of Perry, Georgia (rare); 17 miles northeast of Hawkinsville, Georgia (rare); 3½ miles west of Grovania, Georgia (rare); ½ mile southeast of the Georgia Kaolin Company Mine, Twiggs County, Georgia (rare).

Upper Jacksonian (Ocala limestone): West bank of Sepulga River, Escambia County, Alabama.

*Cotypes.*—Cat. Nos. 64003–64005, U.S.N.M.

### STEGANOPORELLA RECTANGULARIA, new species.

Plate 40, fig. 1.

*Description.*—The zoarium is bilamellar. The $a$ zooecia are short, wide, distinct, ogival, with the distal walls sinuous; the mural rim is thin and salient; the cryptocyst is deep and porous; the polypide tube is somewhat salient and distinct; the two opesiules are rounded, broad, and scarcely visible; the opesium is semilunar and transverse. The $B$ zooecia are much larger; their polypide tube is very salient, and the two opesiules are deep.

*Measurements.*—Opesium $\left\{\begin{array}{l} ho=0.12\text{–}0.14\text{ mm.}\\ lo=0.22\text{–}0.24\text{ mm.}\end{array}\right.$ $a$ zooecium $\left\{\begin{array}{l} Lz=0.44\text{ mm.}\\ lz=0.36\text{ mm.}\end{array}\right.$

$B$ zooecium $\left\{\begin{array}{l} Lz=1.15\text{ mm.}\\ lz=0.55\text{ mm.}\end{array}\right.$

*Affinities.*—Only two specimens have been found, but they appear distinct from *Steganoporella jacksonica* because of their great zooecial width, and by the sinuosities of the distal walls of the mural rim. The species requires further examination.

*Occurrence.*—Lower Jacksonian (Moodys marl): Jackson, Mississippi (very rare).

*Holotype.*—Cat. No. 64006, U.S.N.M.

### STEGANOPORELLA INCRUSTANS, new species.

Plate 40, figs. 2–6.

*Description.*—The zoarium incrusts shells, sometimes forming broad expansions. The $a$ zooecia are small, elongated, distinct; their mural rim prominent, thin; the cryptocyst is deep, smooth or finely granulated; the opesium is semilunar, transverse; there is not a complete polypide tube; the polypidian convexity is prominent; the two opesiules are rounded, asymmetrical, rather distinct. The *B* zooecia are of greater size and much enlarged in their distal part; the polypide tube is median, quite prominent, complete; the opesiules are large, rounded or linear nearly alike; the oral arch is single or double and salient; the distal niche is large, of slight depth, and smooth.

*Measurements.*—Opesium $\begin{cases} ho=0.05\text{–}0.10\text{ mm.} \\ lo=0.20\text{ mm.} \end{cases}$ *a* zooecium $\begin{cases} Lz=0.50\text{ mm.} \\ lz=0.30\text{–}0.36\text{ mm.} \end{cases}$

*B* zooecium $\begin{cases} Lz=0.70\text{–}0.80\text{ mm.} \\ lz=0.34\text{ mm.} \end{cases}$

*Variations.*—The micrometric dimensions are extraordinarily variable. The *B* zooecia attain a length of 1.10 mm. in the specimens from the vicinity of Bainbridge, Georgia; they always engender two new rows of zooecia.

The partition of the *a* zooecia is very oblique and begins at one of the upper distal angles (fig. 5). It becomes very visible after rubbing away the zoarial surface. The polypide slips between this partition and the opesiule in order to emerge from the polypidian convexity.

The polypide tube of the *B* zooecia is median, straight (see fig. 4, *m*), or curved nearly at a right angle. The contortions of the polypide in order to emerge from the zooecium (*d*), are really considerable (fig. 4); we are in ignorance regarding the use of this complicated structure; the embryos developed at the base of the distal chamber are not the cause of it.

One of the zoaria before us covers 5 square centimeters of surface.

*Affinities.*—This species differs from *Steganoporella jacksonica* in its incrusting zoarium, in its *a* zooecia, which are shorter, and its nonperforated cryptocyst.

It is distinguished from *Steganoporella* (*Lepralia*) *firma* Reuss, 1867, by its *B* zooecia, which are much larger.

*Occurrence.*—Upper Jacksonian (Ocala limestone): Chipola River, east of Marianna, Jackson County, Florida (common): West bank of Sepulga River, Escambia County, Alabama (very rare); 4 miles below Bainbridge, Georgia (very rare); Old Factory, 1½ miles above Bainbridge, Georgia (very rare).

Middle Jacksonian: 17 miles northeast of Hawkinsville, Georgia.

*Cotypes.*—Cat. Nos. 64007–64009, U.S.N.M.

### STEGANOPORELLA VICKSBURGICA, new species.

Plate 84, figs. 1–7.

*Description.*—The zoarium is formed of two lamellae placed back to back and easily separable. The *a* zooecia are large, distinct, elongate, without distal niche; the mural rim is thin and salient; the cryptocyst is deep and perforated with very small pores; the opesium semilunar, transverse; the polypide tube is complete but very little prominent, and the opesiules are hardly visible. The *B* zooecia are larger and have a deep, smooth distal niche; the polypide tube is large and very prominent; the opesiules are large, round, and dissimilar; the opesium is surrounded by a small, improminent collar (oral arch).

*Measurements.*—Opesium $\begin{cases} ho=0.30 \text{ mm.} \\ lo=0.40 \text{ mm.} \end{cases}$ *a* zooecia $\begin{cases} Lz=0.75\text{–}0.85 \text{ mm.} \\ lz=0.55 \text{ mm.} \end{cases}$

*B* zooecia $\begin{cases} Lz=1.25 \text{ mm.} \\ lz=0.60 \text{ mm.} \end{cases}$

*Variations.*—This species is rather constant in its characters. The partition which separates the two chambers is horizontal in the *a* and *B* zooecia, so that both kinds of zooecia are provided with a polypide tube, a condition which does not exist in the preceding species studied (*Steganoporella jacksonica*, etc.) (figs. 3, 4). The tube is seen complete after very gently rubbing away the surface of the zoarium (fig. 5).

The dissymmetry of the opesiules is constant, but it is not very great, and certainly the retractor muscles of the polypide were not attached in one of the proximal angles of the zooecium.

In this section it appeared to us that the frontal was a tremocyst resting on an olocyst, but this is a point to be verified. The zooecial mural rim is an olocyst whose elements are grouped in radial rows around the opesium (fig. 6).

The zoarium may attain a length of 2 centimeters; the size of the zooecia permits its determination with a simple hand lens. This is a good-sized fossil and can be readily employed in field determinations.

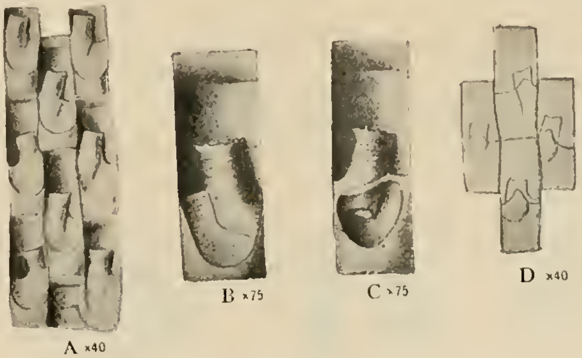


Fig. 72.—Genus *Siphonoporella* Hincks, 1880.

A–D. *Siphonoporella delicatissima* Busk, 1840. A. View of zooecia, × 40, with covering membrane removed. B. Zooecium of same, × 75. C. Zooecium, × 75, showing proximally directed part of polypide tube. D. View from the basal surface, × 40. (A–D after Levinsen, 1909.)

*Occurrence.*—Vicksburgian (Marianna limestone): West bank of Conecuh River, Escambia County, Alabama (common); Salt Mountain, 5 miles south of Jackson, Alabama (common); Murder Creek, east of Castlebury, Conecuh County, Alabama (common); Claiborne, Monroe County, Alabama (common).

*Cotypes.*—Cat. No. 64257, U.S.N.M.

### Genus SIPHONOPORELLA Hincks, 1880.

1880. *Siphonoporella* Hincks, General History of Marine Polyzoa, I. Madeiran Polyzoa, Annals Magazine Natural History, ser. 5, vol. 6, p. 22.

The proximal calcified pad of the frontal wall is formed by a larger or smaller arched gymnocyst; the aperture is not surrounded by a projecting margin; the zooecia occurring only in a single form and provided with a small, always unarmed

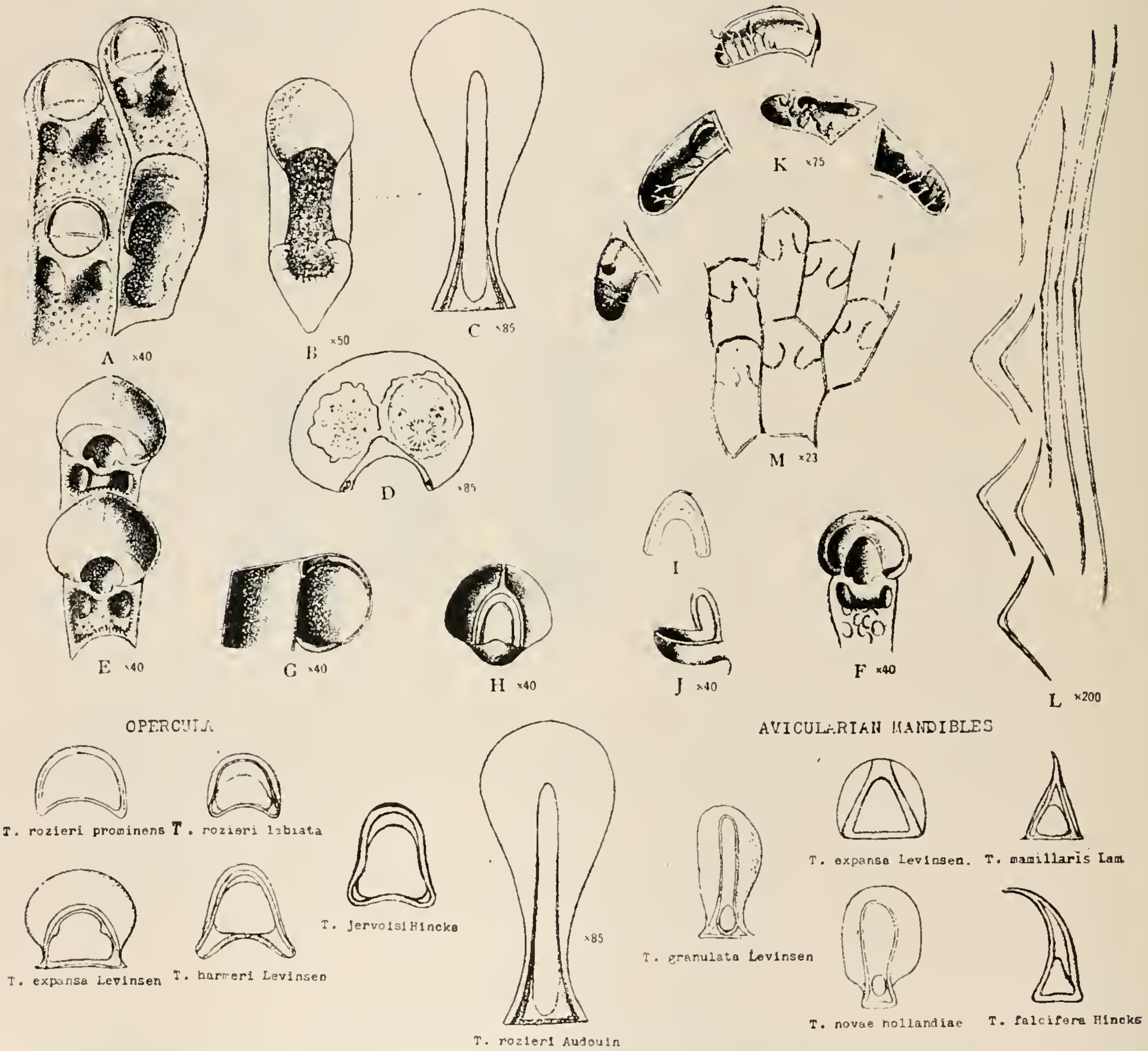

A ×40
B ×50
C ×85
D ×85
E ×40
G ×40
H ×40
I
J ×40
F ×40
K ×75
M ×23
L ×200
OPERCULA
T. rozieri prominens
T. rozieri labiata
T. expansa Levinsen
T. harmeri Levinsen
T. jervoisi Hincks
×85
T. rozieri Audouin
AVICULARIAN MANDIBLES
T. granulata Levinsen
T. expansa Levinsen.
T. mamillaris Lam.
T. novae hollandiae
T. falcifera Hincks

Fig. 73.—Family Thalamoporellidae Levinsen, 1909.

FIG. 73.—Family Thalamoporellidae Levinsen, 1909.

A. *Thalamoporella novae hollandiae* Haswell, 1881. Three zooecia with their operculum and an onychocellarium, × 40. (After Levinsen, 1909.)

B–D. *Thalamoporella rozieri* Audouin, 1826. B, C. Onychocellarium, × 50, and mandible, × 85. D. Section of ovicell, × 85, showing two larvae, of which the right one is clearly older than the left. (B–D after Waters, 1908.)

E. *Thalamoporella granulata* var. *tubifera* Levinsen, 1909. Two gonozooecia. × 40. (After Levinsen, 1909.)

F–J. *Thalamoporella lioticha* Ortman, 1890. F. Median section of ovicell, × 40. G. Schematic longitudinal section through ovicell, × 40. H. Ovicell with frontal half cut away, showing the operculum, × 40. I. Opercula. J. The distal end of a zooecium after the removal of the basal surface; the independent basal wall of the polypide tube is seen, × 40.

K. *Thalamoporella mamillaris* Lamouroux, 1816. Five opesiules of different zooecia, showing the variation in shape of the opesiular outgrowths and in the number and structure of the protecting spinous processes; × 75.

L. Spicula of *Thalamoporella novae hollandiae* Haswell, 1881, × 200.

M. Basal surface of the *Thalamoporella granulata* Levinsen, 1909, × 23, where may be seen the polypidian tube and the opesiular chambers. (F–M after Levinsen, 1909.)

opercular valve; the polypide tube is continued, proximally beneath the cryptocyst cover. (After Levinsen, 1909.)

*Genotype.—Siphonoporella* (*Membranipora*) *delicatissima* Busk, 1861.

## Family THALAMOPORELLIDAE Levinsen, 1909.

The tubifer zooecia have calcareous spicula in the shape of compasses and bows. The ovicells are hyperstomial, with two calcareous layers, springing from the whole anter of the apertura; they are closed by a horizontal cup-shaped chitinized operculum which is connected at its base with the operculum of the gonozooecium. The opesiulae are always completely separated from the apertura. The opercular valve is membranous or chitinized, and more or less completely separated from the ectocyst by a single or double chitinous sclerite. Interzooecial avicularia occur.

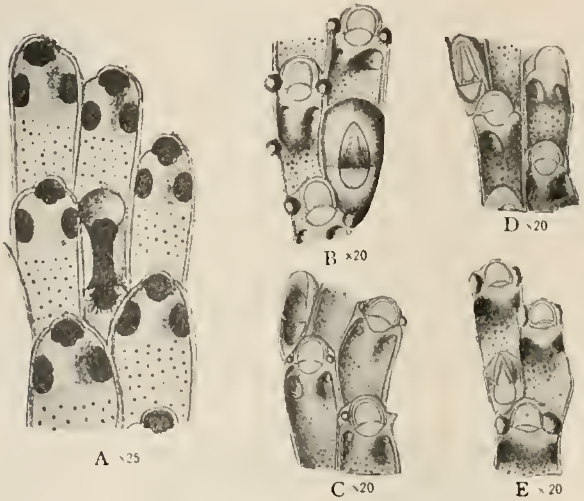


Fig. 74.—Genus *Thalamoporella* Hincks, 1887.

A–E. *Thalamoporella rozieri* Audouin, 1826. A. View of the typical form, × 25. (After Waters, 1908.) B. Zooecia, × 20, of var. *prominens* Levinsen, 1909. C. Zooecia, × 20, of var. *californica* Levinsen, 1909. D. Zooecia, × 20, of var. *sparsipunctata* Levinsen, 1909. E. Zooecia, × 20, of var. *labiata* Levinsen, 1909. (B–E after Levinsen, 1909.)

The principal characters of this family are shown in figure 73. Hitherto it has been considered as appearing first in the Miocene. The only specimens which we have found occur in the topmost beds of the Vicksburgian.

The known genera are *Thalamoporella* Hincks, 1887; *Thairopora* MacGillivray, 1887, *Manzonella* Jullien, 1888, and *Woodipora* Jullien, 1888.

### Genus THALAMOPORELLA Hincks, 1887.

1887. *Thalamoporella* Hincks, Critical Notes on Polyzoa, Annals Magazine Natural History, ser. 5, vol. 19, p. 164.

Characters same as for the family. 17–19 tentacles.

*Genotype.—Thalamoporella* (*Flustra*) *rozieri* (Savigny) Audouin (1812) 1826.

*Range.*—Aquitanian—Recent.

Fossil species of this genus: *Thalamoporella* (*Eschara*) *andegavensis* Michelin, 1846.

### **THALAMOPORELLA PRIMA**, new species.

Plate 85, fig. 14.

*Description.*—The zoarium is bilamellar. The zooecia are distinct, elongated, rectangular, and their mural rims are intimately united among themselves; the cryptocyst is deep, flat, with numerous tremopores. The apertura is orbicular or somewhat transverse, the poster is narrower than the anter; it has a large, distal, vestibular arch; the polypidian tube is invisible. The onychocellarium is straight, oval, narrow, and perforated by a single elliptical orifice.

*Measurements.*—Opesium $\begin{cases} ho=0.12\text{–}0.15 \text{ mm.} \\ lo=0.12\text{–}0.15 \text{ mm.} \end{cases}$ Zooecia $\begin{cases} Lz=0.55 \text{ mm.} \\ lz=0.35\text{–}0.40 \text{ mm.} \end{cases}$

*Affinities.*—Only a few specimens of this species have been found. They are difficult to determine for all the species of the genus are quite polymorphic. To us the present form appeared to differ from *Thalamoporella rozieri* Savigny-Audouin (1826) in its smaller micrometric dimensions ($lz=0.55$ instead of 0.72 mm.).

*Occurrence.*—Uppermost Vicksburgian (Byram marl): Leaf River, Smith County, Mississippi (very rare).

*Holotype.*—Cat. No. 64265, U.S.N.M.

## Division III. PSEUDOSTEGA Levinsen, 1909.

There are no parietal muscles. The hydrostatic system is external; there is a special hypostege on each zooecium.

The families of this division are:

Membranicellariidae Levinsen 1909.
Cellariidae Hincks 1880.
Coscinopleuridae Canu 1913.

We are ignorant of the exact working of the hydrostatic system in the species of this division. It is probable that the lateral incisions of the opesium, otherwise very constant, are in intimate relationship with the entrance or egress of the polypide, for they serve as passage for the liquid of the general cavity in the hypostege or vice versa.

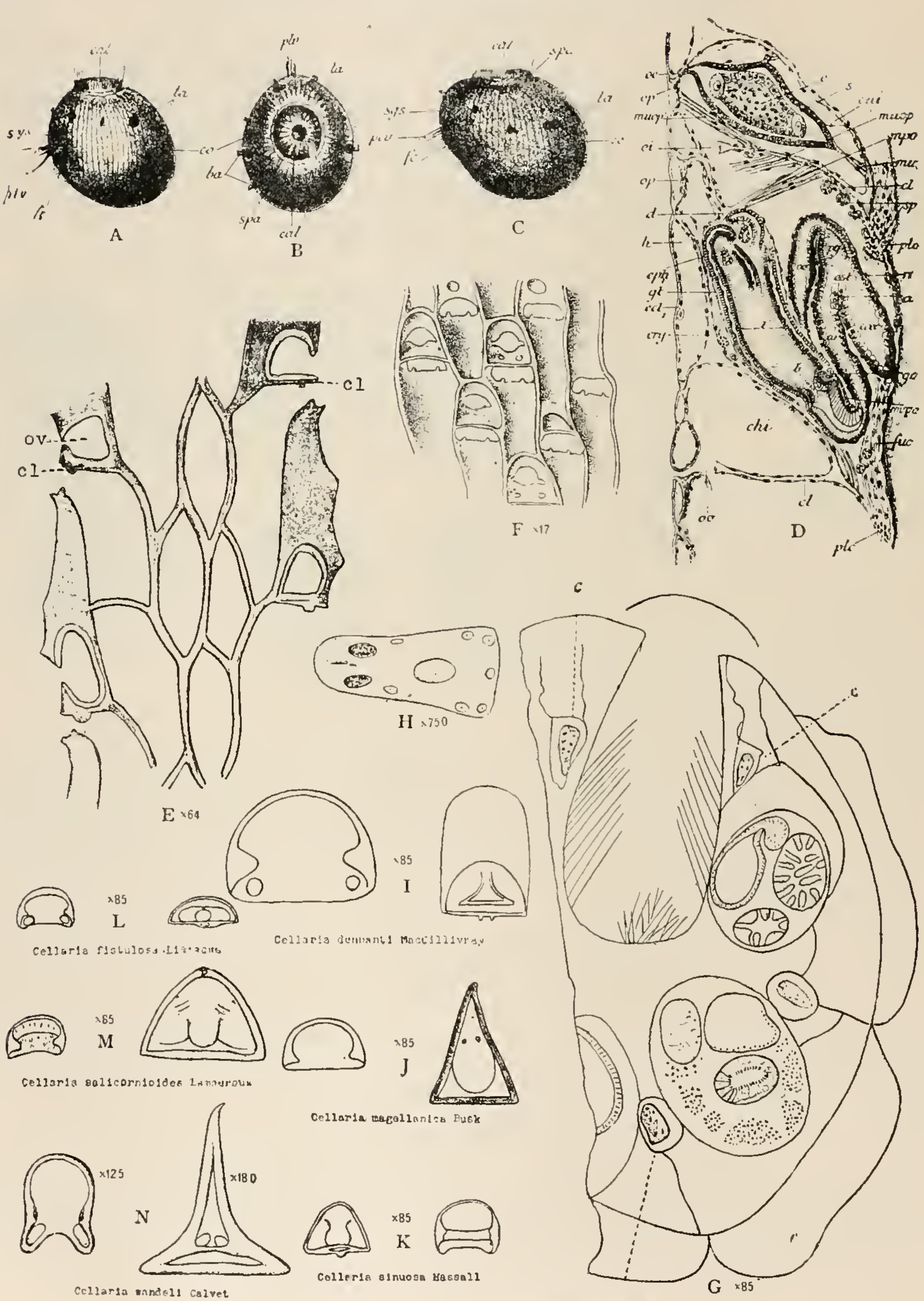
The endocyst covers a hypostege. Its presence is often revealed by supplementary calcareous deposits which may always be distinguished by their irregularity.

Other genera certainly belong to this division, but it has not been possible for us to class them in the families cited. It would be absurd to create a special family for each of them since we lack absolutely the necessary anatomical features.

Here the opesium being entirely closed by a constant operculum of the same form, becomes a real aperture, as in the Ascophora.

### Family CELLARIIDAE Hincks, 1880.

*Bibliography (Anatomical).*—1900, Calvet, Contribution a l'Historie naturelle de Bryozoaires Ectoproctes marines, Montpellier, Mem. 8, pl. 6, fig. 11; pl. 8, fig. 14; pl. 10, fig. 4; pl. 11, figs. 10, 11, 12; pl. 12, figs. 7, 8, 9; pl. 13, figs. 12 to 18.—1904, Waters, Resultats du voyage du S. Y. *Belgica*, Bryozoa (Expedition antarctique belge), pl. 2, fig. 9.—1909, Levinsen Morphological and systematic studies on the Cheilostomatous Bryozoa, p. 209, pls, 7 and 8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fuc
cl
oe
plc
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E ×64
F ×17
H ×750
c
c
G ×85
×85
I
Cellaria dennanti MacGillivray
×85
L
Cellaria fistulosa Linnaeus
×85
M
Cellaria salicornioides Lamouroux
×85
J
Cellaria magellanica Busk
×125
×180
N
Cellaria wandeli Calvet
×85
K
Cellaria sinuosa Hassall

**Fig. 75.—Family Cellariidae Hincks, 1880.**

Fig. 75.—Family Cellariidae Hincks, 1880.

A–D. *Cellaria fistulosa* Linnaeus, 1768. A. Profile view of larva. B. Aboral face. C. Lateral face. (A–C after Calvet, 1900.)

*ba*, palette of pigmentary spots of the larva.
*cal*, calotte (terminal bud).
*co*. corona.
*fc*, ciliated cleft.
*plv*, vibratile plume.
*spa*, palleal furrow.
*sgs*, superior glandular system.
*ta*, pigment spots.

D. Longitudinal frontodorsal section of a bryozoid. (After Calvet, 1900.)

*an*, anus.
*ca*, cardiac region of the stomach.
*cacc*, stomachic caecum.
*chi*, incubation cavity.
*cry*, cryptocyst.
*d*, vaginal diaphragm.
*ϵ*, embryo.
*ect*, ectocyst.
*el*, interzooecial partition.
*eph*, hypostegial epiderm (endocyst).
*cst*, stomach.
*fnc*, central funicular cord.
*gn*, nerve ganglion.
*gt*, tentacular sheath.
*h*, hypostege.
*mpd*, parietal diaphragm muscles.
*mupae*, periesophagial muscular fibers.
*muop*, muscles of the operculum of the ovicell.
*oe*, external orifice of the ovicell.
*oi*, internal orifice of the ovicell.
*op*, operculum.
*plc*, communication plates (septulae).
*rm*, mesenchyme covering of the polypide.
*s*, membraneous sac in which the embryo is evolved.
*t*, tentacles.

E. *Cellaria rigida* MacGillivray, 1887. Longitudinal section through a zoarium, × 64. (After Hennig, 1910.)

F. *Cellaria atlantica* Busk, 1884. Interior from the basal aspect after the removal of the basal surface. The cavities of the zooecia and the ovicells are visible and here and there external ridges which divide the frontal surface into areas. (After Levinsen, 1909.)

G, H. *Cellaria dennanti* MacGillivray, 1887. G. Section × 85, showing the large avicularian chamber, also the outer membranes united at certain points only, and between which there has been a calcareous deposit; the basal portions of the intermediate zooecia are shown at *c*. In the lower zooecium the full number of tentacles is not shown.

H. Section of tentacles, × 750. (G, H after Waters, 1904.)

I–N. Opercula (to the left) and avicularian mandibles (to the right) of Cellaria. (I, M after Waters, 1885 and 1904, and N after Calvet, 1910.)

The whole frontal wall of the zooecia is a cryptocyst and they have a well chitinized, bilaminar, simple operculum with a straight or concave proximal margin. Within the proximal and sometimes also within the distal margin of the aperture is placed a pair of (or sometimes a single broad) supporting teeth. The subopercular area of the avicularia has an unusually strongly developed. sometimes almost complete cryptocyst. The ovicells are endotoichal. (After Levinsen, 1909.)

The genera known are *Cellaria* Authors, *Cianotremella* Canu, 1911, *Melicerita* Milne-Edwards. 1838, *Euginoma* Jullien, 1882, and *Erina* Canu, 1908.

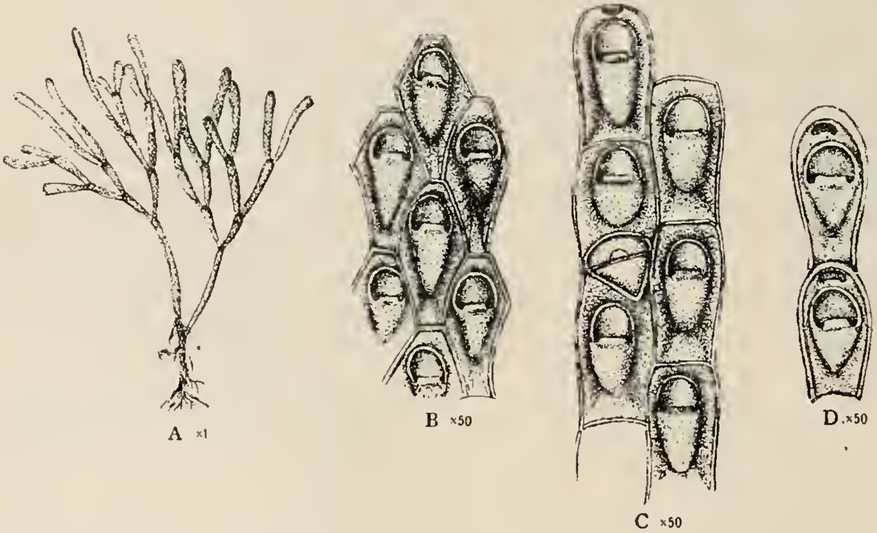

FIG. 76.—Genus *Cellaria* Lamouroux, 1812.

A–D. *Cellaria sinuosa* Hassall, 1841. A. Zoarium, natural size. B. Usual form of zooecia, × 50. C. Zooecia, × 50, with an avicularium. D. Two zooecia, × 50, with ovicells. (A–D after Hincks, 1880.)

There are certainly generic divisions still to be made in the very important genus *Cellaria* when we better understand the function of the oral armature and the working of the hydrostatic system.

### Genus CELLARIA Authors.[1]

The zoarium is articulated, with cylindrical segments (internodes). The ovicell is endotoichal and is closed by a peculiar, chitinous operculum moved by especial muscles. The operculum is formed of a chitinized inner part, closing the aperture, covered by the exterior ectocyst. 13–15 tentacles.

*Genotype.*—*Cellaria fistulosa* Linnaeus, 1768.

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[1] The genus *Cellaria* was named by Lamouroux in 1812, but we cite it as "Authors" to show that we agree with the great majority of the authors of the nineteenth century in regard to this genus. Recently Norman (1903) and Levinsen (1909) have found good cause for bibliographic reasons, to change *Cellularia* to *Cellaria* and *Cellaria* to *Cellularia*. We are absolutely indifferent to these disputes for they do not increase our technical knowledge. The word *Cellaria* is a century old, and as it has always had a distinct meaning, why should we change it?

*Range.*—Jacksonian-Recent.

In the Eocene and the Oligocene we still recognize the single species *Cellaria reussi* D'Orbigny, 1852, of the Priabonian of Vicentin, Italy.

### **CELLARIA STRICTOCELLA, new species.**

Plate 40, figs. 7–10.

*Description.*—Zoarium articulated; the segments cylindrical and symmetrical. The zooecia are elongated, *narrow*, confluent among themselves; the cryptocyst is of little depth, concave, smooth. The aperture is transverse, elliptical, without oral denticles. The ovicell is small, rectangular with an orifice of the same form.

*Measurements.*—Aperture $\left\{\begin{array}{l} ha=0.08 \text{ mm.} \\ la=0.10 \text{ mm.} \end{array}\right.$ Zooecia $\left\{\begin{array}{l} Lz=0.40\text{–}0.45 \text{ mm.} \\ lz=0.25\text{–}0.30 \text{ mm.} \end{array}\right.$

*Affinities.*—Most of the time there is no oral armature; but sometimes deeply embedded lamellae are visible.

The micrometric dimensions are greater in the middle of the segments than at their extremities.

This species differs from *Cellaria reussi* D'Orbigny, 1852, in the form of its zooecia, which are not hexagonal and in their quincunx arrangement.

It differs from *Cellaria dimorpha*, new species, in the absence of all zooecial dimorphism.

*Occurrence.*—Middle Jacksonian (Castle Hayne limestone): Wilmington, North Carolina (uncommon).

*Cotypes.*—Cat. No. 64010, U.S.N.M.

### **CELLARIA DIMORPHA, new species.**

Plate 40, figs. 11–13.

*Description.*—The zoarium is articulated; the segments are large, symmetrical, somewhat conical, formed of a dozen longitudinal rows of dimorphic zooecia. The small zooecia are rectangular, elongated, confluent through their mural rim; the cryptocyst is smooth, deep; the aperture is elliptical and transverse. Within the interior of the aperture there are two oblique symmetrically arranged lamellae. The ovicell is endotoichal; its orifice is circular and completed by a small canal the point of which is below and directed toward the proximal ovicell of the neighboring row. The large zooecia have the same characters as the small.

*Measurements.*—Aperture of small zooecia $\left\{\begin{array}{l} ha=0.10 \text{ mm.} \\ la=0.12 \text{ mm.} \end{array}\right.$ Aperture of large zooecia $\left\{\begin{array}{l} ha=0.20 \text{ mm.} \\ la=0.24 \text{ mm.} \end{array}\right.$

Small zooecia $\left\{\begin{array}{l} Lz=0.50 \text{ mm.} \\ lz=0.20 \text{ mm.} \end{array}\right.$ Large zooecia $\left\{\begin{array}{l} Lz=0.45\text{–}0.55 \text{ mm.} \\ lz=0.26 \text{ mm.} \end{array}\right.$

*Affinities.*—This species is very curious; and for the genus its characters are quite divergent. Unfortunately the different oral organs of the living species have not been thoroughly studied.

The oral lamellae are analogous to those in the genus *Chaperia* where they serve for the insertion of opercular muscles. They are not constant in the large zooecia, where they are sometimes replaced by two lateral denticles.

The orifice of the ovicell has much resemblance to that of avicularia, for it is often constricted by two lateral denticles.

The frontal is an olocyst in which the elements are crowded and regularly disposed. The zooecial *dimorphism* is inexplicable.

*Occurrence.*—Middle Jacksonian (Castle Hayne limestone): Wilmington, North Carolina (common).

*Cotypes.*—Cat. No. 64011, U.S.N.M.

### CELLARIA BIFACIATA, new species.

Plate 40, figs. 14–17.

*Description.*—The zoarium is articulated; the segments are cylindrical and unsymmetrical. On the posterior face the zooecia are small, ogival, joined by their margins; the cryptocyst is smooth and shallow; the aperture is transverse and elliptical. The ovicell is endotoichal; its orifice is large and circular. On the anterior face the zooecia are large, hexagonal, and united among themselves; the cryptocyst is deep, but much smaller than the aperture which is transverse and elliptical. Between the zooecia there are large falciform avicularia in which the pivot is indicated by two large lateral teeth.

*Measurements.*—

| | | | |
|---|---|---|---|
| Aperture of small zooecia | $ha=0.09$ mm.<br>$la=0.10–0.12$ mm. | Small zooecia | $Lz=0.30$ mm.<br>$lz=0.16$ mm. |
| Aperture of large zooecia | $ha=0.12$ mm.<br>$la=0.15–0.20$ mm. | Large zooecia | $Lz=0.35$ mm.<br>$lz=0.33–0.35$ mm. |

*Affinities.*—This species is as remarkable as it is problematical. We know absolutely no other bryozoan with which it can be compared. There are only two rows of the large zooecia, which have considerable resemblance to those of *Onychocella;* the irregularity of the orifice is indicative of an opesium and not an aperture. The avicularium is analogous to that in *Callopora tenuirostris* Hincks. The small zooecia are arranged in six rows. Their aperture is rather small and is without all internal armature. Its ovicell is endotoichal.

*Cellaria bifaciata* certainly belongs to a new genus, but unfortunately the rarity of specimens has not allowed us to make a detailed study.

*Occurrence.*—Middle Jacksonian: Wilmington, North Carolina (rare); near Lenud's Ferry, South Carolina (rare).

*Cotypes.*—Cat. No. 64012, U.S.N.M.

### Genus CIANOTREMELLA Canu, 1911.

1911. *Cianotremella* CANU, Iconographie des Bryozoaires fossiles de l'Argentine, pt. 2, Anales del Museo Nacional de Buenos Aires, vol. 21, p. 257.

Zooecia separated laterally by a thin mural rim. The opesium is formed of a semicircular anter and of a convex poster. The ovicell is endotoichal and opens exteriorly by a salient and transverse pore.

*Genotype.*—*Cianotremella gigantea* Canu, 1911. Rocanean of Argentina.

## Family COSCINOPLEURIDAE Canu, 1913.

1913. Coscinopleuridae Canu, Etudes morphologiques sur trois nouvelles families de Bryozoaires, Bulletin Société Geologique de France, ser. 4, vol. 13, p. 145.

The apertura is semilumar, marginated. anterior, never terminal. The ovicell is hyperstomial, embedded in the distal zooecia, never closed by the operculum. The onychocellaria are straight but typical.

The known genera are:

*Coscinopleura* Marsson, 1887.
*Escharipora* D'Orbigny, 1851.
*Macropora* MacGillvray, 1895.

### Genus COSCINOPLEURA Marsson, 1887.

1887. *Coscinopleura* Marsson, Die Bryozoen der weissen Schreibkreide der Insel Rügen, Palaeontologische Abhandlungen, vol. 4, p. 71.

The margins of the zoarium are bordered by large vibracula. The frontal is deprived of pores and avicularia.

*Genotype.—Coscinopleura* (*Eschara*) *elegans* Hagenow, 1840.

*Range.*—Cenomanian-Thanetian.

This genus is quite remarkable; it realizes the type of special adaptation to the mobile substratum. Very certainly the zoaria were attached to algae in agitated waters. The zoarial equilibrium, constantly compromised, was assured by the vibracula and the hydrostatic zooecia.

The vibracula are powerful and their cilium must be very long; these are the zooecia whose frontal is perforated by large scattered pores; the upper lip of the apertura is quite salient, oblique, truncated, conical. They belong to the type of vibracula of the family of the Lunulariidae. They are placed laterally on the zoarial margins (fig. 13) and at the bifurcations they are often accompanied by hydrostatic zooecia (fig. 12).

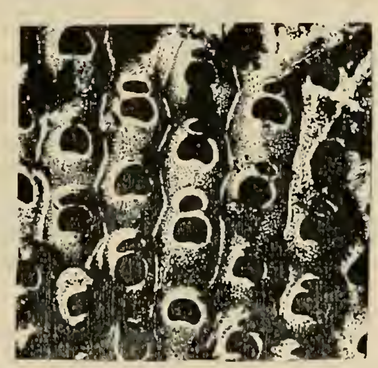

Fig. 77.—Genus *Cianotremella* Canu, 1911.

*Cianotremella gigantea* Canu, 1911. View of zooecia showing salient transverse pore opening of ovicell. (After Canu, 1911.)

The hydrostatic zooecia in our opinion, contained the liquid destined for the zoarial hydrostatic system; they are therefore intended to augment the exterior volume when they empty, and consequently diminish the weight and assure the capacity to float. They are placed laterally (fig. 12) or they are grouped in large number (fig. 21).

Canu, in 1913, cited the known fossil species of this genus.

#### COSCINOPLEURA DIGITATA Morton, 1834.

Plate 2, figs. 7–22.

1834. *Eschara digitata* Morton, Synopsis of the Organic Remains of the Cretaceous Group of the United States, p. 79, pl. 13, fig. 8.

1845. *Eschara digitata* LONSDALE, Account of six species of Polyparia obtained from Timber Creek, New Jersey, Quarterly Journal Geological Society of London, vol. 1, p. 73, figs. *c*, *d*, *g* (*a* and *b* ? exclus. *e* and *f*).

1850. *Eschara digitata* D'ORBIGNY, Prodrome de paleontologie stratigraphique, vol. 2. p. 264.

1862. *Eschara digitata* GABB and HORN, Monograph of the fossil Polyzoa of the Secondary and Tertiary formations of North America, Journal Academy of Natural Sciences of Philadelphia, ser. 2, vol. 5, p. 114.

1901. *Eschara ? digitata* ULRICH, Maryland Geological Survey, Eocene, p. 216, pl. 60. figs. 11, 12.

1907. *Onychocella digitata* WELLER, Geological Survey New Jersey, Paleontology, vol. 4, p. 330, pl. 23, figs. 7–10.

*Description.*—" Zoarium bifoliate, branching dichotomously; branches flattened, acutely elliptical in cross section, usually 2.5 to 3.0 mm. wide. Zooecia hexagonal. regularly arranged in quincunx, about 0.55 long and 0.38 wide, bounded by a slightly impressed line; surface concave, especially toward the aperture, which is situated usually just in front of the center. Aperture semielliptical, rounded in front, straight behind, 0.10 to 0.12 mm. wide. Normally developed and perfect, the posterior border of the aperture is slightly raised and bears a delicate lunarium-like curved plate, which extends into the aperture. Abortive cells, possibly of the nature of vicarious avicularia, are frequent but seem to be entirely restricted to the edges of the zoarium and to those portions lying just beneath the axes of bifurcation. They are distinguished from the other cells by their subcircular and usually smaller apertures. Ooecia unknown." (After Ulrich.)

*Measurements.*—Aperture $\begin{cases} ha=0.15 \text{ mm.} \\ la=0.15 \text{ mm.} \end{cases}$ Zooecium $\begin{cases} Lz=0.60 \text{ mm.} \\ lz=0.40 \text{ mm.} \end{cases}$

This species was discovered in the Eocene by Ulrich in 1901. The description which he gave is correct; nevertheless its "abortive cells" are the vibracula of a perfect and well known type.

The Eocene specimens are a little narrower than those of the Cretaceous at Vincentown.

*Occurrence.*—Lowest Eocene (Bryozoan bed at base of Aquia formation): Upper Marlboro, Maryland (rare).

*Geological distribution.*—Upper Cretaceous (Vincentown marl=Danian): Vincentown and other localities in New Jersey.

*Plesiotypes.*—Cat. Nos. 63785, 63786, U.S.N.M.

## Genus MACROPORA MacGillivray, 1895.

1895. *Macropora* MACGILLIVRAY, Monograph Tertiary Polyza Victoria, Transactions Royal Society Victoria, vol. 4, p. 54.

"The zooecia very thick-walled, provided with pores, but without spines and without opesiules. The zooecial structure is provided with a well-developed vestibular arch. Ovicells and avicularia wanting, but among the zooecia we find some which have an aperture of a different form and whose distal margin is furnished with three membraneous feeler-like filaments. Dietellae." (Levinsen, 1909.)

*Genotype.*—*Macropora centralis* MacGillivray, 1895.

*Range.*—Jacksonian-Recent.

Levinsen classed this genus in the Microporidae, but the absence of the opesiules and parietal muscles oblige us to place it under the Pseudostega. Perhaps it will be convenient to create a family of Macroporidae: but we are absolutely without any knowledge of its anatomical features.

### MACROPORA AQUIAE, new species.

Plate 1, figs. 20, 21.

*Description.*—The zoarium incrusts small shells. The zooecia are hexagonal, somewhat elongated, distinct, separated by a more or less salient thread; the cryptocyst is very slightly concave and quite finely porous. The aperture is semilunar, transverse; its proximal border is straight with two small lateral characteristic indentations; the vestibular arch is very small. There are two pairs of lateral dietellae.

*Measurements.*—Aperture { $ha$=0.04 mm.
$la$=0.08 mm.
Zooecia { $Lz$=0.40 mm.
$lz$=0.20 mm.

*Variations and affinities.*—The micrometric measurements are quite variable. The ancestrula is a zooecium identical with the others. The thread separating the zooecia often becomes quite attenuated. The vestibular arch is visible only when greatly magnified.

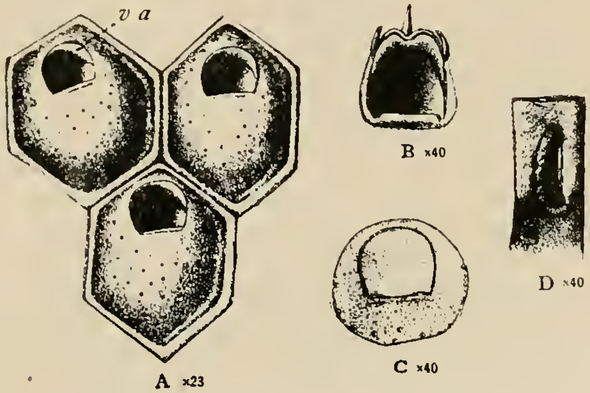

FIG. 78.—Genus *Macropora* MacGillivray, 1895.

A–D. *Macropora centralis* MacGillivray, 1895. A. Three zooecia, × 23.; *va*, vestibular arch. B. The aperture of a special form of zooecium (avicularium?), × 40. C. An operculum with its surroundings, × 40. D. A dietella, × 40. (A–D after Levinsen, 1909.)

The frontal occasionally bears some perforations which appear to be opesiules.

This small species is extremely fragile. It is not rare in the Aquia formation, to which it appears to be restricted.

*Occurrence.*—Lowest Eocene (Bryozoan bed at base of Aquia formation): Upper Marlboro, Maryland (not uncommon).

*Holotype.*—Cat. No. 63780, U.S.N.M.

### MACROPORA MULTILAMELLOSA, new species.

Plate 41, figs. 1–3.

*Description.*—The zoarium is multilamellar and incrusts algae or creeps over the sand; the zooecia of the upper and external lamella only are living. The external zooecia are hexagonal, elongated, distinct, separated by a prominent thread;

the cryptocyst is smooth, slightly convex. The aperture is semilunar, transverse; the proximal border is straight with two small lateral slits. The zooecia of the internal lamellae have a granulated cryptocyst and their apertures are closed by a calcareous lamina. Five dietellae are present.

*Measurements.*—Aperture $\begin{cases} ha = 0.12 \text{ mm.} \\ la = 0.17 \text{ mm.} \end{cases}$ Zooecia $\begin{cases} Lz = 0.85\text{–}0.90 \text{ mm.} \\ lz = 0.65\text{–}0.75 \text{ mm.} \end{cases}$

*Variations.*—This species is a true *Macropora;* the aperture does not occupy all the distal extremity and is provided with a decided peristome and a small vestibular arch; the zooecia are exactly hexagonal; there are five dietellae.

The granular constitution of the inner zooecia is quite remarkable. These granules are equivalent to the "hydrostatic tuberosities;" their object is to keep the upper zooecial lamella at a distance to avoid an intimate contact analogous to that of other multilamellar bryozoa. They are secreted by the endocyst which floats in the hypostege (Calvet) and forms a special pleurocyst. These zooecia were without polypide, since their aperture was closed by a calcareous lamina secreted by the endocyst; but they might have continued to live, to be traversed by the mesenchymatous filaments of the endocyst, since the granulations are formed only at the moment of the formation of the upper lamella.

The zoarial unity of the bryozoa is incontestable since the larva is unique, but it often manifests itself in a rather obscure fashion in the incrusting species. In the present instance it appears as if a real intelligence presided over the vital manifestations at the moment of their necessity.

The utility of the frontal granulations is not evident at first glance, but it is easy to find their explanation by examining the whole of the zoarium. The granules are really hydrostatic and are also designed to augment the volume and the lightness of the zoarium. The larva affixes itself to sand grains, over which the zoarium spreads rapidly. This is a very dangerous habitat, as the sand is in danger from the least movement of the water. To avoid this the animal multiplies its lamellae, preparing for itself in this way its own foundation; by the specific lightness thus acquired it may have the power to elevate itself above the sand and avoid this dangerous zone. It is evident that the zoarium is entirely surrounded by the ectocyst and that the disruption of this would impede the working of the hydrostatic system.

At the bottom of each zooecium there are two oblique, projecting lamellae which serve as supports for the upper lamella.

*Affinities.*—We have not found an ovicell, and in spite of its appearance this species is not a *Coscinopleura.* It differs from *Macropora centralis* MacGillivray, 1895, and from *Macropora clarkei* Tenison Woods in its frontal tuberosities and in its multilamellar zoarium. These two species are from the Miocene of Australia.

The genus *Macropora* is unknown in Europe. However, in the English Cretaceous there is *Homolostega cuniformis* Brydone, 1900, which may be either a *Macropora* or a *Coscinopleura*, but of which the ovicell is not yet known.

*Occurrence.*—Middle Jacksonian (Castle Hayne limestone): Wilmington, North Carolina (common); Eutaw Springs, South Carolina (common); near Lenuds Ferry, South Carolina (common).

*Cotypes.*—Cat. No. 64015, U.S.N.M.

### Genus QUADRICELLARIA D'Orbigny, 1850.

1850. *Quadricellaria* D'ORBIGNY, Paléontologie française, Terrain crétacé, Bryozoaires, p. 32.

Zoarium articulated; segments quadrangular; two opposite faces with large zooecia and the other two with small zooecia.

*Genotype.*—*Quadricellaria elegans* D'Orbigny.

*Range.*—Turonian-Senonian.

D'Orbigny's genus is rather well delimited, but it has been extended to include all forms with rectangular zoaria. Moreover, it is more of a zoarial form than a thoroughly established genus.

The two species which we doubtfully classify in *Quadricellaria* have in effect quadrangular segments, but their affinities are with *Macropora.* The specimens are not ovicelled and can not be positively classified generically at the present time.

#### QUADRICELLARIA (?) LACINIOSA, new species.

Plate 40, figs. 18–20.

*Description.*—The zoarium is articulated, with segments quadrangular; each face bears on each zooecium a large *slit* in the form of a crescent. The zooecia are quite elongate, distinct, formed of two parts. A shallow, very finely punctate cryptocyst and an inferior triangular gymnocyst. The aperture is semilunar and surrounded by a prominent peristome; the proximal border is straight with two small lateral slits. The ovicell is endotoichal.

*Measurements.*—Aperture $\left\{\begin{array}{l} ha=0.08 \text{ mm.} \\ la=0.06 \text{ mm.} \end{array}\right.$ Zooecia $\left\{\begin{array}{l} Lz=0.50 \text{ mm.} \\ lz=0.22 \text{ mm.} \end{array}\right.$

*Affinities.*—The zooecia are joined back to back and arranged in alternating pairs at right angles, as in *Dimetopia.*

This species is not a *Quadricellaria* and certainly belongs to a new genus, although different from the genus represented in *Quadricellaria burnsi.* To create this genus one should know the ovicell and possess many specimens. We have only collected three segments.

*Occurrence.*—Middle Jacksonian (Castle Hayne limestone): Wilmington, North Carolina (very rare).

*Cotypes.*—Cat. No. 64013, U.S.N.M.

#### QUADRICELLARIA (?) BURNSI, new species.

Plate 40, fig. 21.

*Description.*—The zoarium is articulated and radicellated; it contains a row of zooecia on each of the four faces. The zooecia are quite elongate, distinct, bordered by a very slightly elevated mural rim; the cryptocyst is smooth and shallow.

The aperture is semilunar or ogival and is surrounded by a prominent peristome; its proximal border is straight with two small lateral slits; there is a vestibular arch.

*Measurements.*—Aperture $\begin{cases} ha=0.08 \text{ mm.} \\ la=0.06 \text{ mm.} \end{cases}$ Zooecia $\begin{cases} Lz=0.44\text{–}0.46 \text{ mm.} \\ lz=0.20 \text{ mm.} \end{cases}$

Breadth of the segments 0.20–0.36 mm.

*Affinities.*—This species is articulated as in *Cellaria;* but in its other characteristics it is nearer to *Macropora.* As in that genus, there is a peristome, an oral arch, and two oral slits. We have not seen an ovicell. It is impossible to establish a new genus on such insufficient material as we possess, since the figured specimens are the only ones which have been found. We dedicate this species to Dr. Frank Burns, who collected many species of Tertiary bryozoa for our study.

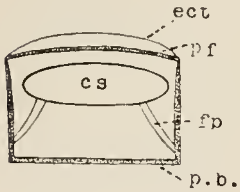

Fig. 79.—Structure of the Ascophora Levinsen, 1909.

Transverse section of a zooecium. *cs,* compensatrix; *ect,* ectocyst; *fp,* parietal fibers (muscles); *pb,* basal skeleton wall; *pf,* frontal skeletal wall.

*Occurrence.*—Middle Jacksonian (Castle Hayne limestone): Wilmington, North Carolina (very rare).

*Holotype.*—Cat. No. 64014, U.S.N.M.

## Suborder Ascophora Levinsen, 1909.

The zooecial hydrostatic system is a sack or compensatrix placed under the frontal and in which the sea water is introduced. The parietal muscles are attached to this sack.

### The COSTULAE.

(Family CRIBRILINIDAE Hincks, 1880.)

The zooecia have their frontal wall formed of flattened ribs ordinarily hollow, radiating from the outer border toward the median line of the zooecia, where they are intimately joined together; these ribs are united to one another, sometimes by a more or less large number of transverse passages, and sometimes border to border, the ribs, however, always remaining apparent.

This family is not natural, for its essential characters are too much at variance. We indicate, therefore, the anatomical bibliography for each of the genera studied. In the future, these genera will probably be distributed in the Malacostega and Ascophora. The anatomical researches published have shown the presence of a compensatrix, for which reason we classify the group in the Ascophora; but we recognize that certain genera are unprovided with this organ.

*Terminology.*—The internal structure of the Costulae has been carefully studied by Norman.[1] The costula (A) (bar of Norman) always has its proximal extremity rounded (fig. 80), forming the loop of Norman or talon of Jullien (C). This structure is hollow; the hollow part is the lumen line or more simply the *lumen.* There are often openings in the lumen called lumen pores. The sides of the costules are the lateral lines (D); the pore-like openings generally developed between them are the *lateral lacunae;* the openings developed at the extremities are *median lacunae.* A lateral lacuna consists then of two parts divided horizontally (E), taking their origin in the lateral walls of two adjacent costules. A median lacuna consists of two vertical portions formed by the distal extremities of two opposite costules (F).

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[1] 1903, Annals and Magazine Natural History, ser. 7, vol. 12, p. 90.

*Classification.*—For the reception of species of this family, D'Orbigny in 1852 created the two families of Escharellidae (without avicularia) and Eschariporidae (with avicularia). These names prevailed for 30 years.

In 1880 Hincks showed that *Cribrilina* Gray, 1848, has priority over *Escharipora* D'Orbigny, 1852, and made this genus the type of the Cribrilinidae.

In 1886 J. Jullien[1] established that *Membraniporella* was not a true member of the Cribrilinidae. Thus regarding the family of Hincks in a different sense, especially since he added to it the Steginoporidae D'Orbigny, he gave it another name—the Costulidae.

The classification adopted by the French author is based chiefly on the form of the aperture and on the development of the oral spines. Most of his genera may be preserved with some modification of diagnosis.

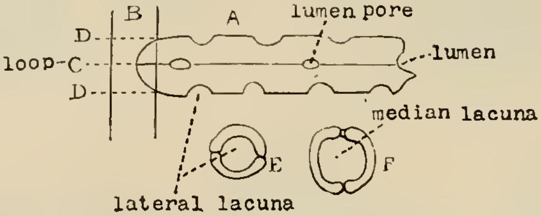

FIG. 80.—Sketch showing structure of a costule. (After Norman, 1903.)

In 1909 Levinsen established that Hincks' family was not natural, that certain genera have affinities with the Anasca and others with the Ascophora.

Our studies of the American bryozoa confirm Levinsen's views, but we can not discover the true affinities of each genus, because it is from the larva alone that these can be demonstrated. The attention of the zoologists is called to this, as well as to the great number of other unsolved problems in the science of bryozoology.

Spines more or less joined together occur in the genus *Scrupocellaria* and in the family Catenicellidae, but the formation of the costules is the enigma of bryozoology.

The accompanying figures give a summary of the principal genera known in this so-called family.

### Genus MEMBRANIPORELLA Smitt, 1873.

1873. *Membraniporella* SMITT, Floridan Bryozoa, Kongl. Svenska Vetenskaps-Akademiens Handlingar, vol. 10, No. 11, p. 10.

*Bibliography* (*anatomical*).—1877. BARROIS, Recherches sur l' embryologie des Bryozoaires, pl. 8, figs. 27, 29, 32.—1899. WATERS, Bryozoa from Madeira, Journal of the Royal Microscopical Society, pl. 3, figs. 18, 19.—1903. C. NORMAN, Notes on the Natural History of East Finmark, Annals Magazine Natural History, ser. 7, vol. 12, pl. 8, fig. 8.—1909. LEVINSEN, Morphological and Systematic Studies on the Cheilostomatous Bryozoa, pl. 9, fig. 9.

The costules are provided with a large lumen of greater or less size, without pores, and are completely joined or are separated by long slits; usually no lumen

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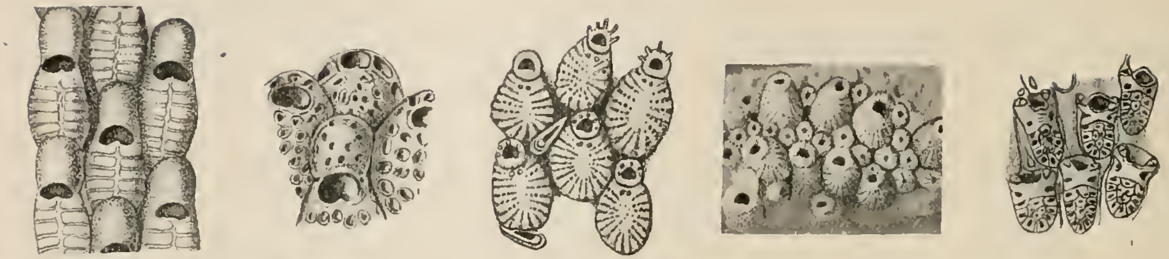
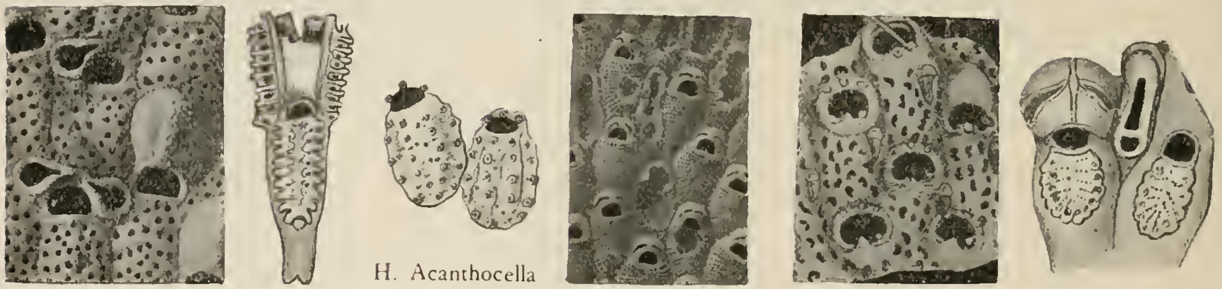
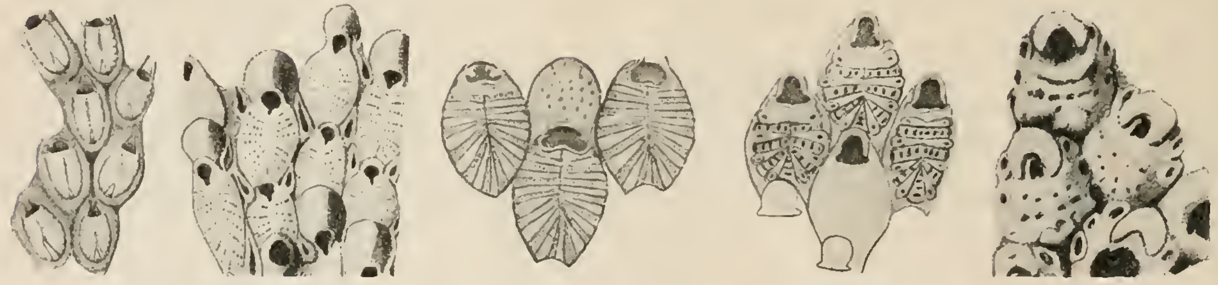
[1] The Costulidae, Bulletin de la Société Zoologique de France, vol. 11, p. 2.



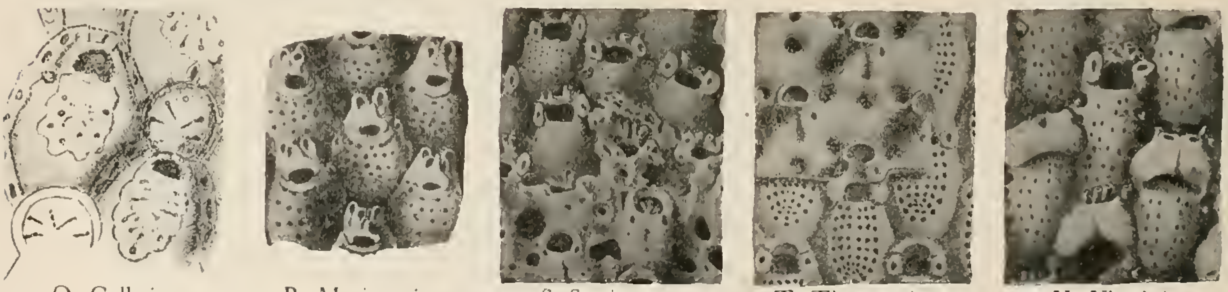
A. Membraniporella B. Cribrilina C. Puellina D. Distanseschcharella E. Gephyrotes



F. Metracolposa G. Corbulipora H. Acanthocella I. Cribrendoecium J. Arachnopusia K. Figularia



L. Aspidelectra M. Barroisina N. Reginella O. Lyrula P. Decurtaria



Q. Collarina R. Murinopsia S. Steginopora T. Thoracophora U. Ubaghsia

Fig. 81.—Genera of the Costulae.

FIG. 81.—Genera of the Costulae.

A. *Membraniporella nitida* Johnston, 1838. Recent.

B. *Cribrilina punctata* Hassel, 1841. Recent.

C. *Puellina radiata* Moll, 1803. Recent.

D. *Distansescharella jacksonica*, new species, × 30. Middle Jacksonian of Georgia.

E. *Gephyrotes nitida-punctata* Smitt, 1868. Recent.

F. *Metracolposa grandis*, new species. × 20. Middle Jacksonian, Wilmington, North Carolina.

G. *Corbulipora ornata* MacGillivray, 1895. Miocene of Australia.

H. *Acanthocella tubulifera* Hincks, 1881, × 25. Recent.

I. *Cribrendoecium tenuicostulatum* Canu and Bassler, 1917. Middle Jacksonian, Wilmington, North Carolina.

J. *Arachnopusia monoceros* Busk, 1880, × 25. Recent.

K. *Figularia figularis* Johnston, 1847, × 30. Recent.

L. *Aspidelectra melolontha* Busk, 1852, × 25. Recent.

M. *Barroisina elegantula* Von Hagenow, 1851. Cretaceous of Aachen.

N. *Reginella furcata* Hincks, 1882. Recent.

O. *Lyrula hippocrepis* Hincks, 1882. Recent.

P. *Decurtaria cornuta* Beissel, 1864. Cretaceous of Aachen.

Q. *Collarina cribrosa* Heller, 1867. Recent.

R. *Murinopsis galeata* Beissel, 1864. Cretaceous of Aachen.

S. *Steginopora ocellata* Jullien, 1886. Cretaceous of France.

T. *Thoracophora horrida* D'Orbigny, 1852. Cretaceous of France.

U. *Ubaghsia arcifera* Jullien, 1886. Cretaceous of France.

pores. There are two pairs of lateral dietellae and a distal dietella. The ovicell is hyperstomial and is always closed by the operculum. The avicularia are always dependent. The aperture is closed by an opercular valve. The larva is that of the Escharines (Ascophora).

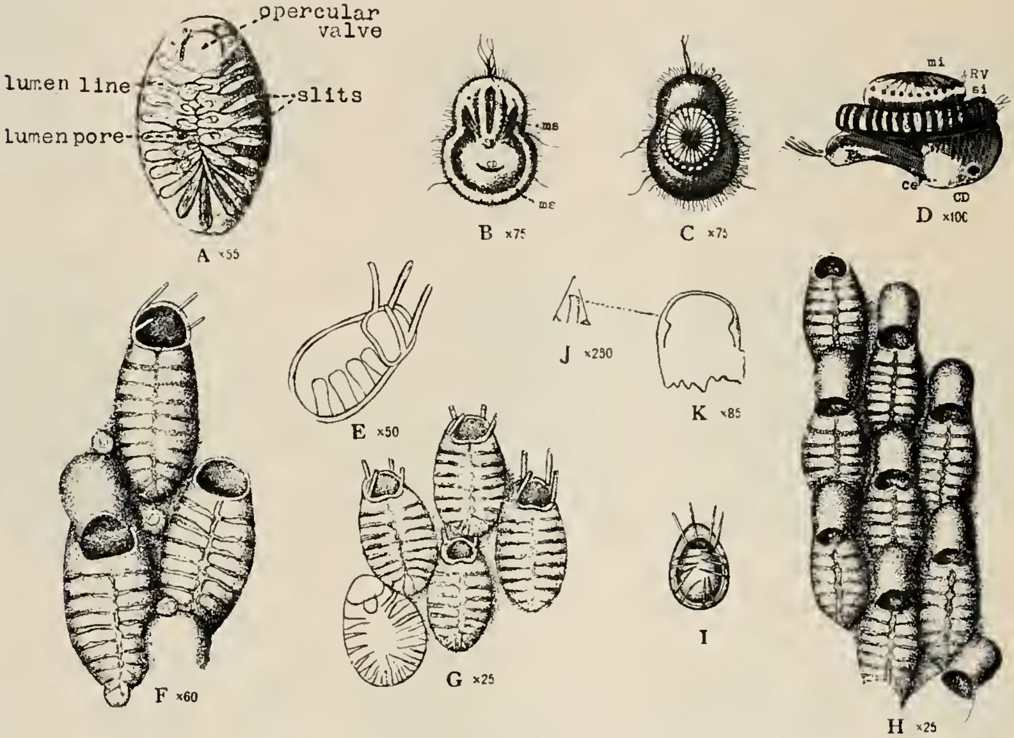


FIG. 82.—Genus *Membraniporella* Smitt, 1873.

A. *Membraniporella distans* MacGillivray, 1885. A. Zooecium, × 55, showing terminology. (After Levinsen, 1909.)

B–K. *Membraniporella nitida* Johnston, 1838. B. Larva, oral face, × 75. C. Aboral view of larva, ×75. D. Free larva seen in profile, × 100. (B–D after Barrois, 1877.)

*C. D.*, digestive cavity.
*ce*, obscure portion of the cavity of the body included between the two branches of the stomach.
*mi*, aboral mesoderm.
*ms*, oral mesoderm (labial).
*o*, mouth of the gastrula.
*Ph*, pharynx.
*rv*, border of the terminal bud.
*si*, furrow separating the terminal bud and the lower portion of the aboral face.

E. Outline showing the structure of the cell, × 50. (After Hincks, 1880.)

F, G, H. Various forms of this species. I. Ancestrula. (F–I after Hincks, 1880.) J. Mandible, × 250. K. Operculum, × 85, showing it continuous with the membrane (opercular valve). (J, K after Waters, 1899.)

*Genotype.—Membraniporella* (*Lepralia*) *nitida* Johnston, 1838.

*Range.*—Cenomanian-Recent.

Levinsen believed that this genus was very close to *Callopora* Gray, 1848, and that it could well be classified in the same family. But the larva is that of the Ascophora, although it is true that Barrois's determination of the larva has never been verified, and that we have no information on the anatomy or larva of species of *Callopora*. Therefore, while awaiting more information, we must be content with a classification which, if it is not natural, is at least very convenient.

The intervening slits are often accompanied by lacunae, as in the other genera of this group. The presence of the latter is therefore not an exclusive character if the other important characters, absence of lumen pores, and the ovicell always closed by the operculum, are present.

### MEMBRANIPORELLA MODESTA Ulrich, 1901.

Plate 1, figs. 22–25.

1901. *Cribrilina modesta*, ULRICH, Maryland Geological Survey, Eocene, p. 218, pl. 60, fig. 14.

*Original description.*—"Zoarium forming a delicate parasitic patch upon foreign bodies. Zooecia ovate, not very regularly arranged, about 0.4 mm. in length and 0.28 mm. wide, bordered by a thin rim. Front wall gently convex, usually with six (five to seven) radiating and transverse furrows, or triangular space, including five or six similar pores placed in obscure transverse furrows. Apertures rounded, prominent, oblique, the posterior edge highest and often thickened in its central portion. Small avicularian cells occur near or attached to one part or another of the apertural rim of most zooecia, generally one to each, rarely two. Ooecia cucullate, moderately arched."

This is a true *Membraniporella;* the slits are wide and complete. The lumen is often visible. The ovicell is embedded in the distal zooecia and its orifice is lower than the labial mucro.

*Occurrence.*—Lowest Eocene (Bryozoan bed at base of Aquia formation): Upper Marlboro, Maryland (rare).

*Plesiotypes.*—Cat. No. 63781, U.S.N.M.

### MEMBRANIPORELLA CRASSULA Ulrich, 1901.

Plate 1, fig. 26.

1901. *Cribrilina crassula* ULRICH, Maryland Geological Survey, Eocene, p. 218, pl. 60, fig. 14.

*Original description.*—"Zoarium encrusting. Zooecia oblong, quadrate, or hexagonal, irregularly arranged, with a heavy, strongly elevated margin, clithridate in outline. Front wall with a narrow raised ridge running down its center, and five or six transverse and radiating rows of minute punctures lying in furrows. Apertures rounded or subovate, the outline often less curved on the posterior side than elsewhere. Avicularian cells small, raised, variously distributed, sometimes one or two and three to a zooecium; or a cell may have none at all. Ooecia unknown. Zooecia 0.5 to 0.6 mm. in length, 0.25 to 0.30 mm. wide; about seven in 4 mm. measuring lengthwise."

*Occurrence.*—Lowest Eocene (Bryozoan bed at base of Aquia formation): Upper Marlboro, Maryland (rare).

### MEMBRANIPORELLA CRASSICOLLIS, new species.

Plate 4, figs. 24, 25.

*Description.*—The zoarium is bilamellar and free. The zooecia are little distinct, being confluent by their mural rims, elongated, fusiform; the area is cribriform, contains three to five pairs of transversal slits, and is deep and flat. The aperture is suborbicular, somewhat transverse, and is surrounded by a thick, prominent peristome. The ovicell is small, salient, convex, smooth; it is always closed by the operculum. There is often a large, simple, round avicularium placed on the mural rim to the right or the left.

*Measurements.*—Aperture $\begin{cases} ha=0.12 \text{ mm.} \\ la=0.15 \text{ mm.} \end{cases}$ Zooecium $\begin{cases} lz=0.35 \text{ mm.} \\ Lz=0.70 \text{ mm.} \end{cases}$

*Affinities.*—The prominence of its peristome characterizes this species. It differs from *Membraniporella planula* in its costules, which are not flat, and in the zooecial mural rims, which are joined to one another.

From *Membraniporella bioculata* it may be distinguished by its less numerous slits and by the entire absence of an oral mucro.

*Occurrence.*—Midwayan: One mile west of Fort Gaines, Georgia (rare); Mabelvale, near Little Rock, Arkansas (rare).

*Cotypes.*—Cat. No. 63806, U.S.N.M.

### MEMBRANIPORELLA PLANULA, new species.

Plate 5, figs. 8–10.

*Description.*—The zoarium is free and bilamellar. The zooecia are distinct, separated by a furrow, elongated, fusiform, bordered by a thin mural rim; the cribriform area is of little depth, formed of flat costules, and contains five or six pairs of transverse slits. The aperture is semilunar. The two small oral avicularia are symmetrically placed on the distal part of the mural rim; the pivot is indicated by two lateral denticles.

*Measurements.*—Aperture $\begin{cases} ha=0.10\text{–}0.12 \text{ mm.} \\ la=0.12 \text{ mm.} \end{cases}$ Zooecia $\begin{cases} Lz=0.85 \text{ mm.} \\ lz=0.36 \text{ mm.} \end{cases}$

*Affinities.*—The micrometrical measurements are rather variable. Those given above correspond to figure 9, but in figure 8 the zooecia are smaller. In the interior (fig. 10) the measurements are from 0.95 to 1.10 mm. for the length and from 0.30 to 0.35 mm. for the width.

This species differs from *Membraniporella crassicollis* in its more numerous, flat costules, in the absence of a prominent peristome, and in its zooecia, which are separated by a deep furrow.

Compared with *Membraniporella ulrichi* it may be distinguished by its much smaller and less constant oral avicularia ($Lv$ 0.15 mm. and not 0.25 mm.) and by the much larger slits of the cribriform area (0.05 mm. and not 0.01 mm.).

*Occurrence.*—Midwayan (Clayton limestone): Mabelvale, near Little Rock, Arkansas (rare); Luverne, Crenshaw County, Alabama (rare).

*Cotypes.*—Cat. Nos. 63808, 63809, U.S.N.M.

### MEMBRANIPORELLA ULRICHI, new species.

Plate 41, figs. 4, 5.

*Description.*—The zoarium is free, bilamellar, bush-like. The zooecia are little distinct, joined together by their mural rim, thin, very elongated, lozenge-shaped; the cribriform area is shallow, flat, and contains 10 to 12 very narrow transverse slits; the axis of the suture of the costules is salient. The aperture is elongated, semilunar; its proximal border is provided with a quite salient thorn-like projection. The ovicell is large, embedded in the distal zooecia, salient, globular, always closed by the operculum, and formed of two calcareous lamellae, of which the outer one is porous. The two oral avicularia are large, fusiform, and prominent; the pivot is indicated by two small, lateral teeth.

*Measurements.*—Aperture $\left\{\begin{array}{l} ha=0.17 \text{ mm.} \\ la=0.15 \text{ mm.} \end{array}\right.$ Zooecia $\left\{\begin{array}{l} Lz=1.00 \text{ mm.} \\ lz=0.35\text{–}0.40 \text{ mm.} \end{array}\right.$

*Affinities.*—This fine species is very constant in all its characters. A tangential thin section (fig. 5) shows that the costules are formed of rather large, scattered olocystal elements, regularly placed.

*Membraniporella ulrichi* differs from *Membraniporella planula* in its mural rims, which join each other; in its much larger avicularia ($Lv=0.25$ mm.); in the extreme thinness of the lumen (0.01 mm.), and in the sharpness of the proximal border of the aperture.

It can be distinguished from *Membraniporella bioculata* by its small and non-bifurcated oral prominence, by its much smaller and more numerous costules, by its larger avicularia ($Lv=0.25$ mm.) and by its much longer ovicells (*hov* 0.20 mm. instead of 0.15 mm.).

We dedicate this species to Dr. Edward O. Ulrich, whose brilliant work on the Paleozoic bryozoa has a world-wide reputation, and who was among the first to take up the serious study of the American Tertiary forms.

*Occurrence.*—Middle Jacksonian: near Lenuds Ferry, South Carolina (abundant); Eutaw Springs, South Carolina (abundant); Wilmington, North Carolina (rare).

*Cotypes.*—Cat. No. 64016, U.S.N.M.

### MEMBRANIPORELLA BIOCULATA, new species.

Plate 41, figs. 11–13.

*Description.*—The zoarium incrusts bryozoa. The zooecia are distinct, separated by a furrow, elongate, elliptical; the cribriform area is very convex, containing five or six pairs of radial slits. The costules have a lumen pore at the loop. The aperture is semilunar; the proximal edge has a large bifurcated mucro, the branches of which frequently rejoin the oral avicularia, thus forming a new orifice above the aperture; distal spines are sometimes present. The ovicell is prominent, globular, smooth, little sunken in the distal zooecia, always closed by the operculum. The two oral avicularia are salient, oval, the point at the top; the pivot is calcareous or simply indicated by two lateral denticles.

*Measurements.*—Aperture $\left\{\begin{array}{l} ha=0.10\text{ mm.}\\ la=0.15\text{ mm.}\end{array}\right.$ Zooecia $\left\{\begin{array}{l} Lz=0.60\text{ mm.}\\ lz=0.35\text{ mm.}\end{array}\right.$

*Affinities.*—The development of the oral mucro is remarkable; it is well illustrated in figure 12. The two nearly vertical arches situated under the two bifurcations of the mucro circumscribe two large pores (or *eyes*), which may be distinguished clearly from the underlying radial lumen on the cribriform area. In the Cretaceous there are other spinose growths still more remarkable, as in the genus *Steginopora* D'Orbigny, 1852.

The secondary orifice, which results from this development of the oral mucro, is smaller and more irregular than the primary one or apertura, which is only slightly visible.

The oral spines are rarely seen; when they exist, they are four in number and are never borne by zooecia with avicularia.

This species differs from *Membraniporella ulrichi* in its incrusting zoarium, its very convex cribriform area, its smaller oral avicularia (*Lv* 0.20 mm. and not 0.25 mm.), and in its smaller ovicell.

We have seen only three specimens of this remarkable species, so we are unable to make a more detailed study.

*Occurrence.*—Middle Jacksonian: near Lenuds Ferry, South Carolina (rare).

*Cotypes.*—Cat. No. 64021, U.S.N.M.

### MEMBRANIPORELLA COMPRESSA, new species.

Plate 41, fig. 6–8.

*Description.*—The zoarium is free, cylindrical, or *compressed.* The zooecia are distinct, elongated, elliptical, separated by a furrow, and surrounded by a more or less developed gymnocyst. The frontal is quite convex; the costules are delicate without lumen pores, largely separated by a long initial slit following two lacunae. The ovicell is unknown. The aperture is transverse, semi-elliptical, and provided with a slightly salient and very thin border.

*Measures.*—Aperture $\left\{\begin{array}{l} ha=0.09\text{ mm.}\\ la=0.12\text{ mm.}\end{array}\right.$ Zooecia $\left\{\begin{array}{l} Lz=0.50\text{ mm.}\\ lz=0.30\text{ mm.}\end{array}\right.$

*Affinities.*—Norman[1] has shown that in the variety *intermedia* of *Membraniporella nitida*, the type of the genus: "the radiating ribs coalesce with each other by crossbars so as to form roundish openings, lateral lacunes;" and that, "in fact, this Madeiran form in its structure is in all respects a true *Cribrilina*."

We have noted also that *Membraniporella subagassizi* with reference to the separating slits of the zooecia may or may not have such lacunae.

Here the lacunae are constant. But we can not classify the species in *Cribrilina* because of the initial slit and the absence of lumen pores, nor in *Puellina* because of the great size of the lacunae and of the initial slit. Provisionally at least, the species may be retained in *Membraniporella* Smitt.

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[1] 1909, Norman On the Polyzoa of Madeira and neighboring islands, Journal Linnean Society, vol. 31, p. 288, pl. 36, fig. 7.

The gymnocyst which surrounds the cribriform area is very inconstant and is developed chiefly in the lower part of the zooecia.

This species differs from *Membraniporella subagassizi* in its zoarial dimensions, its much smaller micrometric measurements, and its numerous frontal lacunae.

*Occurrence.*—Middle Jacksonian: Eighteen miles west of Wrightsville, Johnson County, Georgia (rare); one-half mile west of Georgia Kaolin Company's Mine, Twiggs County, Georgia (rare).

*Cotypes*—Cat. Nos. 64017, 64018, U.S.N.M.

### MEMBRANIPORELLA MONILIFERA, new species.

Plate 41, figs. 9, 10.

*Description.*—The zoarium incrusts shells. The zooecia are distinct, separated by a furrow, elongated, elliptical, wide; the frontal is convex; the costules are radially arranged, united near the zoarial axis, separated by long, rather wide slits, and ornamented with two tuberosities of which one is a talon. The aperture is semi-elliptical and is limited by a thin peristome which bears at least two large, hollow spines and, in front, by a calcareous thickening in the form of a T. The ovicell is closed by the operculum. There is a vestibular arch and four spines, of which the first pair is the larger.

*Measurements.*—Aperture $\begin{cases} ha = 0.07 \text{ mm.} \\ la = 0.07 \text{ mm.} \end{cases}$ Zooecia $\begin{cases} Lz = 0.50 \text{ mm.} \\ lz = 0.35\text{–}0.40 \text{ mm.} \end{cases}$

*Variations.*—This species is characterized by its two costular tuberosities; one is at the aperture itself and the other is close to the zooecial axis. The general effect of these tuberosities is that of a double *necklace* around the zooecia.

The part formed by the union of the costules forms in front of the zooecia a sort of shield of variable size.

Very often the costular tuberosities do not exist; the zooecia then have the aspect of a very simple *Membraniporella.*

There are no lumen pores.

*Affinities.*—This species differs from *Membraniporella bioculata* in its smaller micrometric dimensions, the absence of oral avicularia, and the presence of tuberosities on the costules. In its incrusting zoarium it differs from all the other species of *Membraniporella* studied.

*Occurrence.*—Middle Jacksonian: near Leunds Ferry, South Carolina (rare); Eutaw Springs, South Carolina (rare).

*Cotypes.*—Cat. Nos. 64019, 64020, U.S.N.M.

### MEMBRANIPORELLA (?) SUBAGASSIZI, new species.

Plate 84, figs. 8–13.

*Description.*—The zoarium is free, cylindrical, formed of five or six longitudinal rows of zooecia. The zooecia are large, distinct, separated by a furrow, elliptical; the frontal is very convex and formed by a cribriform area surrounded by a smooth gymnocyst; the cribriform area contains 10 to 12 transversal and radial costules. Each costule is separated from its neighbor by a large lacuna followed by a smaller circular lacuna. The aperture is suborbicular with a concave lower lip. The ovicell is enormous, globular, very prominent, pierced with small pores widely spaced. The ovicelled zooecia bear at the right and left of the aperture two large, symmetrical lamellae forming a sort of peristomie. The operculum never closes the ovicell. On each zooecium there are one or two large, oval avicularia very prominent and triangular, with a pivot. the point turned toward the aperture.

*Measurements.*—Aperture $\begin{cases} ha=0.29 \text{ mm.} \\ la=0.25 \text{ mm.} \end{cases}$ Zooecia $\begin{cases} Lz=1.00\text{–}1.10 \text{ mm.} \\ lz=0.45 \text{ mm.} \end{cases}$

*Variations.*—The more or less complete arch which is formed above the aperture of the ovicelled zooecia is evidently designed to facilitate the passage of the eggs and is a pseudo peristomie. The small lacuna is not always present (figs. 11, 12); the aspect is then that of a true *Membraniporella.* On the old zoaria (fig. 11) the gymnocyst is thickened and shows a mural rim around the cribriform area.

In this species the lateral clefts are the intercostal spaces. In figure 12 notably the lumen is clearly visible in the costules and in the broken zooecia. The costules appear to be hollow.

We note again that the operculum does not close the ovicell as in the other species of the genus.

In the future it may be necessary to classify this species in the genus *Corbulipora* MacGillivray, 1895, when we are better acquainted with the structure of that genus.

*Affinities.*—This species is very close to *Membraniporella agassizi* Smitt, 1873,[1] which lives to-day in the Gulf of Mexico and in the waters off Florida. It is distinguished by the absence of a transverse rib on the ovicell, by the different form of the avicularia and the larger micrometric dimensions ($la=0.25$ mm. and not 0.16 mm.).

The genus *Corbulipora* is a member of the Cribrilinidae with a vincular zoarium, but quadriserial. In our species the zooecia are in six series and appear to differ otherwise generically.

It is moreover quite remarkable to find in the Eocene species almost identical with those now living off the coast of Florida. This is proof of the calm tectonic conditions in this region during all the Tertiary period.

*Occurrence.*—Vicksburgian ("Chimney rock" of Marianna limestone): One mile north of Monroeville, Alabama (common).

*Cotypes.*—Cat. No. 64258. U.S.N.M.

### Genus CRIBRILINA Gray, 1848.

1848. *Cribrilina* Gray, List British Animals in British Museum, pt. 1, Centroniae, p. 116.

*Bibliography* (*Anatomical*).—1894. Levinsen, Zoologica danica, p. 61, pl. 5, figs. 7–22.—1900. Waters, Bryozoa from Franz Joseph Land, Linnean Society Journal, Zoology, vol. 28, p. 52, pl. 8, figs. 21, 22.—1903. Norman, Notes on the Natural History of East Finmark, Annals Magazine Natural History, ser. 7, vol. 12, p. 93, pl. 8, fig. 10.—1909, Levinsen, Morphological and Systematic Studies on the Cheilostomatous Bryozoa, p. 158, pl. 9, fig. 11.

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[1] 1875, Smitt, Floridan Bryozoa, Kongl. Svenska Vetenskaps-Akademiens Handlingar, vol. 10, p. 11, pl. 5, figs. 103–106.

The zooecium is closed by an opercular valve. The costules are generally closely consolidated together; the lacunae are large and few in number; the lumen is more or less distinct. The dietellae are irregular in number (at least three lateral pairs). The ovicell is hyperstomial and is always closed by the operculum. The orifice often has a mucro. The avicularia are dependent.

*Genotype.—Cribrilina punctata* Gray, 1848.

*Range.*—Midwayan-Recent.

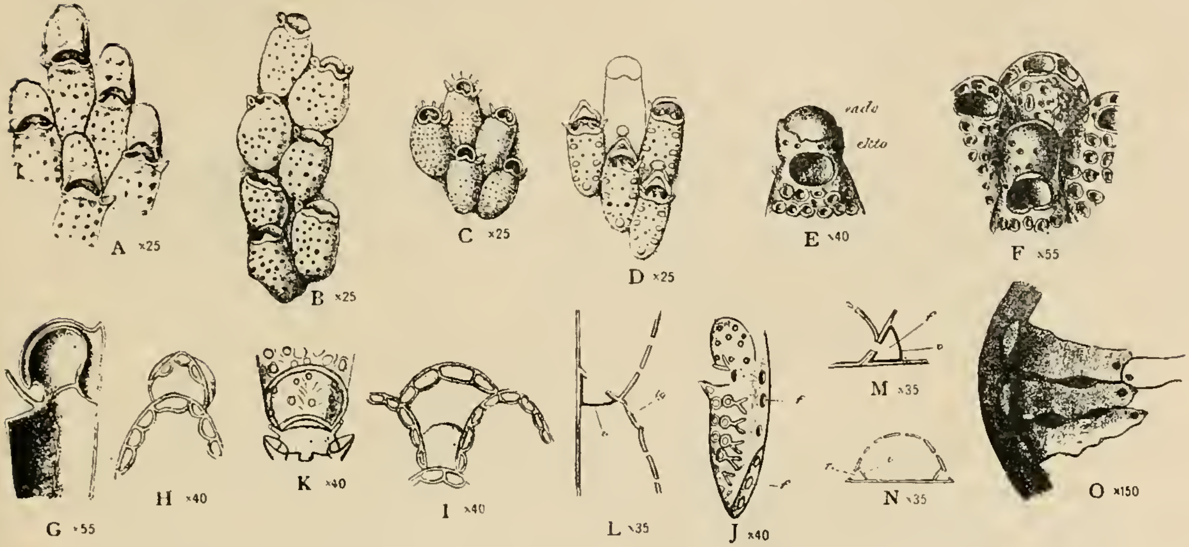

Fig. 83.—Genus *Cribrilina* Gray, 1848.

A–N. *Cribrilina punctata* Hassal, 1841. A–D. Various forms of the species, × 25. (After Hincks, 1880.) E. Ovicell, × 40. The endooecium (olocyst) (*endo*) is visible through the broken ectooecium *ekto*. F. Dietellae are seen on the three marginal zooecia, of which the central abnormal one has no aperture, × 55. G. Sagittal section through a zooecium with ovicell. The ovicell is inclosed in a kenozooecium (cavity), × 55. The distal end of a zooecium with ovicell, from the basal surface. The dietellae of the zooecium and kenozooecium are seen, × 40. I. Dietellae from the basal surface, × 40. (E–I after Levinsen, 1909.) J. Zooecium seen in profile, × 40: *f*, septula. K. Ovicell and avicularian cavity, × 40. L–N. Schematic sections through the dietellae, × 35. (J–N after Levinsen, 1894.) O. *Cribrilina annulata* Fabricius, 1780. Three bars of the zooecium of a very simple form, × 150. (After Norman, 1903.)

### CRIBRILINA VERRUCOSA, new species.

Plate 5, figs. 12–14.

*Description.*—The zoarium incrusts other bryozoa. The zooecia are distinct, separated by a deep furrow, elongated, elliptical, crenulated on their borders. The cribriform area is convex and formed of large, radial costules; the lacunae are very large, prominent, irregularly placed at the rate of 1 to 2 to each pair of adjacent costules. The aperture is semilunar and is at the bottom of a very small vestibule. The two small oral avicularia are peristomial, simple, and without pivot.

*Measurements.*—Aperture $\begin{cases} ha=0.10 \text{ mm.} \\ la=0.10\text{–}0.11 \text{ mm.} \end{cases}$ Zooecia $\begin{cases} Lz=0.40\text{–}0.45 \text{ mm.} \\ lz=0.30\text{–}0.35 \text{ mm.} \end{cases}$

*Variations.*—The general effect of the lacunae gives to the zooecia a very characteristic *warty* aspect. These small ornaments are very fragile; they are much attenuated by fossilization, which gives the species such a very variable aspect. It is likewise often difficult to perceive the costular radiations.

On the proximal lip of the aperture there is often a convex sinuosity or a kind of indistinct mucro.

The lumen line is rarely visible (fig. 14).

*Affinities.*—This species differs from *Cribrilina rathbunae* in its larger dimensions, its more prominent lacunae, and its more regular zoarial margins.

*Occurrance.*—Midwayan (Clayton limestone): Mabelvale, near Little Rock, Arkansas; Luverne, Crenshaw County, Alabama (common); 1 mile west of Fort Gaines, Georgia (common); Brundige, Alabama (common).

*Cotypes.*—Cat. Nos. 63811, 63812, U.S.N.M.

### CRIBRILINA LATICOSTULATA, new species.

Plate 5, fig. 11.

*Description.*—The zoarium incrusts shells. The zooecia are distinct, separated by a deep furrow and are somewhat elongated and elliptical; the frontal is quite convex and formed of 12 to 14 large and *wide costules*, separated from each other by 5–6 lacunae; and united at their extremities. The apertura is semicircular, bordered by a salient peristome bearing two spines on the distal part and a salient and thick mucro on the proximal part. The ovicell is hyperstomial placed on the distal zooecium, it is globular, salient and never closed by the operculum. Above each zooecium there is a small, simple, orbicular or elliptical avicularium.

*Measurements.*—Apertura $\begin{cases} ha=0.05 \text{ mm.} \\ la=0.08 \text{ mm.} \end{cases}$ Zooecium $\begin{cases} Lz=0.36 \text{ mm.} \\ lz=0.26 \text{ mm.} \end{cases}$

*Variations.*—This species is quite rounded, which causes the lacunae to disappear. The mucro is quite salient and is raised in front of the orifice of the ovicell; it manifestly protects the passage of the eggs. The spines are extremely fragile and have been observed only in two cases.

The costules are intimately joined on the median axis. We have never observed the pores of the papillae. For these reasons we class this species provisionally in *Cribrilina*, but we believe that the operculum does not close the ovicell. It is evident that the latter character is always problematic on the fossils.

*Occurrence.*—Midwayan (Clayton limestone): Brundidge, Alabama (rare).

*Holotype.*—Cat. No. 63810, U.S.N.M.

### CRIBRILINA RATHBUNAE, new species.

Plate 5. figs. 15–17.

*Description.*—The zoarium incrusts other bryozoa. The zooecia are elongated, distinct, elliptical; the cribriform area is somewhat convex and formed of transverse costules; the lacunae are large and prominent, 1 to 2 to each pair of adjacent costules. The aperture is semilunar, transverse, bordered by a thin, smooth, improminent peristome. The two small oral avicularia are simple, peristomial, and without pivot.

*Measurements.*—Aperture $\begin{cases} ha=0.07 \text{ mm.} \\ la=0.10 \text{ mm.} \end{cases}$ Zooecia $\begin{cases} Lz=0.35\text{–}0.45 \text{ mm.} \\ lz=0.25 \text{ mm.} \end{cases}$

*Variations and affinities.*—The lacunae are variable in number on each zooecium; their prominence is much lessened by fossilization.

This species differs from *Cribrilina verrucosa* in its smaller zooecial dimensions and its less convex cribriform area.

This interesting species is named in honor of Miss Mary J. Rathbun, of the United States National Museum, as a slight appreciation of her valuable work upon marine invertebrates.

*Occurrence.*—Midwayan: Mabelvale, near Little Rock, Arkansas (very rare).

*Cotypes.*—Cat. No. 63813, U.S.N.M.

### Genus PUELLINA Jullien, 1886.

1886. *Puellina* JULLIEN, Les Costulidées. Bulletin Société Zoologique France, vol. 11, p. 7.

*Bibliography (Anatomical).*—1902. HARMER, On the Morphology of the Cheilostomata. Quarterly Journal of Microscopic Science, vol. 46, pp. 2, 293, 326, pl. 15, fig. 7.—1903. NORMAN, Notes on the Natural History of East Finmark, Annals Magazine Natural History, ser. 7, vol. 12, p. 96, pl. 9, figs. 3, 4, 5.—1909. LEVINSEN, Morphological and Systematic Studies on the Cheilostomatous Bryozoa, p. 159, pl. 9, fig. 12.

The lacunae between the costules are very small; the lumen, more or less visible, bears many pores, of which the first in the shield is larger than the others. The aperture is semicircular. The operculum is simple and entirely chitinous. The ovicell is hyperstomial and always closed by the operculum. Between the costular shields are papillae. The dietellae number at least three lateral pairs.

*Genotypes.*—*Puellina* (*Cribrilina*) *gattyae* Busk, 1852, and *Puellina* (*Cribrilina*) *radiata* Moll, 1803.

*Range.*—Senonian-Recent.

The papillae are short, tentaculiform evaginations. The first pair, near the aperture, is always the larger by far. They have been considered as true avicularia (Jullien) as sensorial vibracula (Smitt) or as simple appendages corresponding to the spines of the ancestrula (Harmer). Their place is almost invisible on the fossils. Levinsen limits this genus to species provided with an interzooecial avicularium. However, it would be difficult for us to classify our *Puellina bispinosa* and *Puellina simulator* in another genus.

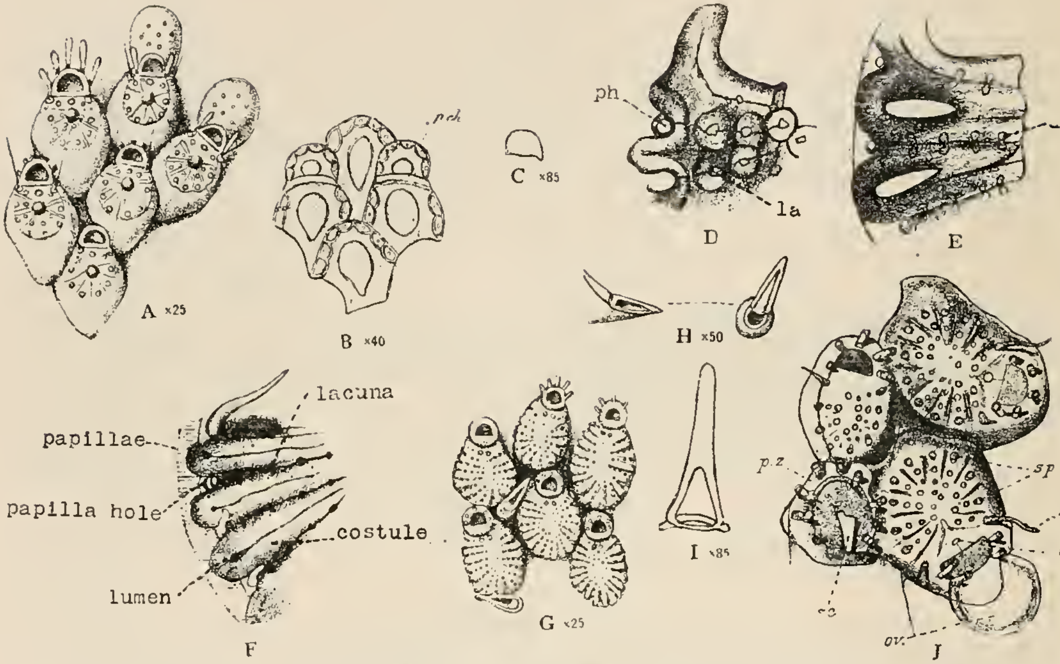

FIG. 84.—Genus *Puellina* Jullien, 1886.

A–E. *Puellina gattyae* Busk, 1852. A. Zooecia and ovicells. × 26. (After Hincks, 1880.) B. Zooecia from the basal surface. The dietellae (*psch*) surround the zooecia and their ovicells, × 40. (After Levinsen, 1909.) C. Opercular valve. × 85. (After Waters, 1878.) D. Anterior portion of a zooecium of the ordinary form. E. Variety, with interesting duplicated lateral lacunae. (Figs. D, E. After Norman, 1903.) *dla*, duplicated lateral lacuna; *la*, lacuna; *ph*, papillae holes.

F. *Puellina innominata* Couch, 1844. Sketch showing terminology. Three costules of a zooecium showing the lateral papillae and a small opening outside the arch of the costule, into the body of the polyzoon, which a papilla has occupied. (After Norman, 1903.)

G–J. *Puellina radiata* Moll, 1803. G. Zooecia with avicularia, × 25. H. Avicularian mandibles, × 50. (G, H. After Hincks, 1880.) I. Avicularian mandible, × 85. (After Waters, 1885.) J. Primary zooecium (*pz*) and three younger zooecia. The frontal flustrine membrane (*pz*) is overarched by a proximal scutum-like spine (*sc*) while the ten other spines bear minute horizontal calcareous lobes which project from the inner sides. The oral spines of the zooecium bear similar lobes. In all except the primary zooecium (ancestrula) the series of oral spines is continued by the pair of elongated membraneous spines (*sp*) (papillae of Norman) on either side of the median pore (*mp*) and further by the small papillae (*sp′*) (papillae holes of Norman) which correspond with the marginal spines of the primary zooecium. The series of pores are in the same radii as those modified spines. The pore chambers (dietellae) are not indicated. (After Harmer, 1902.)

### PUELLINA, species undetermined.

Plate 5, fig. 21.

We have found a single specimen of a small *Puellina* in the Midwayan at Luverne, Alabama, which is figured on plate 5. We believe it is *Puellina radiata* Moll, 1803, or one of its varieties, but unfortunately the specimen has no ovicell and the avicularia are incomplete. It is preferable to wait for good material before making a definite identification.

*Occurrence.*—Midwayan (Clayton limestone): Luverne, Crenshaw County, Alabama.

### PUELLINA RADIATA Moll, 1803.

Plate 41, figs. 14–18.

*Bibliography (zoological).*

1803. *Eschara radiata* MOLL, Die Seerinde, p. 63, pl. 4, fig. 7.

1889. *Cribrilina radiata* JELLY, A synonymic catalogue. p. 68 (Bibliography general).

1909. *Cribrilina radiata* WATERS, Report on the Bryozoa of the Sudanese Red Sea, Linnean Society Journal, vol. 31, p. 143.

1909. *Cribilina radiata* NORMAN, On the Polyzoa of Madeira and neighboring islands, Journal Linnean Society, vol. 30, p. 291 (zoological bibliography).

*Bibliography (paleontologic references with illustrations).*

1847. *Cellepora scripta* REUSS, Die fossilen Polyparien des Wiener Tertierbeckens, Haidingers' naturwissenschaftliche Abhandlungen, vol. 2. p. 82, pl. 9, fig. 28.

1847. *Cellepora megaecephala* REUSS, Die fossilen Polyparien des Wiener Tertierbeckens, Haidinger's naturwissenschaftliche Abhandlungen, vol. 2, p. 83, pl. 10, fig. 5.

1852. *Semieschariipora pulchella* D'ORBIGNY, Paleontologie française, Terrains crétacés, p. 480.

1864. *Lepralia scripta* REUSS, Zur Fauna der deutschen Oberoligicäns, Sitzungsberichte der k. Akademie der Wissenschaften, vol. 50, p. 641, (28), pl. 15, fig. 3.

1869. *Lepralia innominata* MANZONI, Bryozoici pliocenci italiani, Sitzungsb. d. k. Akademie der Wissenschaften, ser. 1, vol. 59, p. 8, pl. 2, fig. 13.

1874. *Lepralia scripta et rarecosta* REUSS, Die fossilien Broyozoen des Österreichisch-ungarischen Miocäns, I; Denkscriften der k. Akademie der Wissenschaften, vol. 33, p. 25, pl. 1, fig. 7; pl. 6, fig. 1.

1875. *Lepralia cribrilina* MANZONI, I Briozoi del pliocene antico di Castrocaro, vol. 46, p. 27, pl. 3, fig. 40.

1875. *Lepralia innominata* MANZONI, I Briozoi del pliocene antico di Casthocaro, vol. 46, p. 17, pl. 7, fig. 85.

1875. *Lepralia scripta* MANZONI, I Briozoi del pliocene antico di Castrocaro, vol. 46, p. 18, pl. 11, fig. 25.

1875. *Lepralia rarecosta* MANZONI, I Briozoi del pliocene antico di Castrocaro, vol. 46, p. 28, pl. 6, fig. 76.

1895. *Cribilina radiata* DE ANGELIS, Descripción de los Briozoos fosiles pliocenicos de Cataluña, p. 11, pl. B, fig. 10.

1895. *Cribrilina radiata* NEVIANI, Briozoi fossili della Farnesina e Monte Mario, Paleontographia italica, vol. 1, p. 103 (27), pl. 5. fig. 20 (not 21).

1900. *Cribrilina radiata* NEVIANI, Brozoi neogenici delle Calabrie Paleontographia italica, vol. 6, p. 170 (56), Italian bibliography.

1891. *Cribrilina radiata* WATERS, North Italian Bryozoa, Quarterly Journal Geological Society, vol. 47, p. 16.

1904. *Cribrilina radiata* CANU, Étude des Bryozoaires tertiaires recueillis en 1885, dans la region sud de la Tunisie, Exploration scientifique de la Tunisie, p. 18, pl. 34, fig. 23.

1909. *Cribrilina radiata* CANU, Bryozoaires fossiles des Terraines du sud ouest de la France, III, Burdigalien, Bull. Soc. Géol. France. ser. 4, vol. 9, p. 499, pl. 15, fig. 12.

1912. *Cribrilina radiata* CANU, Étude des Bryozoaires helvétiens de l'Egypte, Mémoires de l'Institut Egyptien, vol. 6, p. 206, pl. 10, fig. 13.

The bibliography of this species is somewhat confused. *Cribrilina innominata* Couch, 1844, is a distinct species, as was established by Neviani in 1900 and by Norman in 1909. We have done away with the old synonyms.

According to Neviani, *Cribrilina raricosta* Reuss, 1874, is a good variety, recognizable by its very small dimensions.

There is one variety which has a frontal ascopore, namely, *Lepralia innominata* Busk, 1859, or *Lepralia scripta* Manzoni, 1870, which we have not included in the preceding bibliography. However, according to Norman, it is subject to great variation, and, awaiting agreement among the zoologists, it has not been made a distinct variety.

To these varieties we add two others, *anaticula* and *carolinensis*.

The characteristics of the typical form of the species are: First, the aperture is semilunar and surrounded by four or five large spines. Second, the ovicell is keeled in front and always closed by the operculum. Third, the very long, interzooecial avicularium is terminated by a very thin little canal.

The number of costules, in the recent specimens, is generally from 16 to 18. In the fossil forms their number is from 10 to 12. It is impossible to establish a variety upon this difference, for the costular variations in this species are extraordinary.

Certain specimens have very prominent costules; on others they are scarcely visible.

The ancestrula is a zooecium of the Membranipore type, surrounded with spines (figs. 16, 17).

The micrometric measurements are useless, for they are too variable.

*Occurrence.*—Middle Jacksonian: Wilmington, North Carolina (common); near Lenuds Ferry, South Carolina (common); Eutaw Springs, South Carolina (common); 3¼ miles south of Perry, Georgia (common); 18 miles west of Wrightsville, Johnson County, Georgia (common).

Upper Jacksonian (Ocala limestone): Chipola River, east of Marianna, Jackson County, Florida (common).

Vicksburgian (Marianna limestone): One mile north of Monroeville, Alabama (common); Salt Mountain, 5 miles south of Jackson, Alabama (rare); 3 miles southeast of Vosburg, Jasper County, Mississippi.

*Geological distribution.*—In Europe *Puellina radiata* is found in all the formations since the Lutetian.

*Habitat.*—The living form is cosmopolitan in the two hemispheres. It has been found in the Atlantic at Madeira, Florida, France, and the British Isles; in the Indian Ocean at Zanzibar; in the Pacific at the Philippine Islands, Australia, and Tahiti; and in the Mediterranean, France, Algeria, Tunis, Italy, and the Adriatic.

Specimens have been dredged to a depth of 180 meters, but they live habitually near the shores in the shallower waters. Its occurrence in the Priabonian of the Vicentin and in the waters of Madeira renders its presence inevitable in the American Upper Eocene.

*Plesiotypes.*—Cat. Nos. 64022–64024, U.S.N.M.

### PUELLINA RADIATA ANATICULA, new variety.

Plate 41, fig. 19.

This variety is characterized by the little canal of the avicularium, which is enlarged like the beak of a duck. All the other characters are identical with the type form.

*Occurrence.*—Middle Jacksonian: Seventeen miles northeast of Hawkinsville, Georgia (very rare).

Upper Jacksonian (Ocala limestone): Seven miles above Bainbridge, Georgia (very rare); Bainbridge, Georgia (very rare); 4 miles below Bainbridge, Georgia (very rare).

Vicksburgian (Byram marl): Byram, Mississippi (rather rare).

*Holotype.*—Cat. No. 64025, U.S.N.M.

### PUELLINA RADIATA CAROLINENSIS Gabb and Horn, 1862.

Plate 41, fig. 20.

1862. *Repteschorella carolinensis* GABB and HORN, Monograph Secondary and Tertiary Polyzoa of North America, Journal Academy Natural Science, Philadelphia, vol. 5, p. 136, pl. 19, fig. 18.

This variety is characterized by its smooth peristome, without tuberosities, and by the small distal canal of the avicularium, which is larger than in the type. In reality the spines have not disappeared; on the perfect specimens they are still visible; but they never have the size and the importance of those which decorate the type. The zooecia are a little larger and have 16 costules.

*Occurrence.*—Middle Jacksonian: Near Lenuds Ferry, South Carolina (rare).

Upper Jacksonian (Ocala limestone): West bank of Sepulga River, Escambia County, Alabama (rare).

Vicksburgian (Marianna limestone): One mile north of Monroeville, Alabama (rare).

Vicksburgian (Red Bluff clay): Seven and one-half miles southwest of Bladen Springs, Alabama (rare).

*Plesiotype.*—Cat. No. 64026, U.S.N.M.

### PUELLINA BISPINOSA, new species.

Plate 41, fig. 22.

*Description.*—The zoarium incrusts shells (chiefly *Ostrea vicksburgensis*) and other bryozoa. The zooecia are elongated, distinct, separated by a furrow, elliptical; the frontal is convex and formed of from 16 to 18 thin costules separated by very small lacunae and traversed by a line of lumen pores. The aperture is formed of a semilunar anterior and of a very convex posterior portion separated by two very small cardelles; the posterior portion is hidden by a small, prominent mucro. The ovicell is globular, salient, always closed by the operculum. On each side of the aperture there are two small triangular avicularia pointed, longitudinal, between which occur *two* large spines.

*Affinities.*—This variety differs from *Puellina calamorpha* Reuss, 1866, in that the avicularia are longitudinally disposed, the point toward the top, instead of being oblique and even transverse, in the two large oral spines instead of five small ones and especially in its elongated (not transverse) and much larger ovicell.

The micrometric measurements are very variable.

*Measurements.*—Aperture $\begin{cases} ha=0.04 \text{ mm.} \\ la=0.06 \text{ mm.} \end{cases}$

| | | Long. | Medium. | Short. |
|---|---|---|---|---|
| Zooecium | $Lz=$ | 0.50 mm. | 0.40 mm. | 0.34 mm. |
| | $lz=$ | 0.24 mm. | 0.30 mm. | 0.24 mm. |

This species differs from *Puellina radiata* Moll, 1803, only in the presence of two oral avicularia. However, Hincks calls attention to some small similar avicularia in Moll's species. In our opinion he discussed a distinct species, a fact which he had not noticed. It could very well be, also, that *Puellina calamorpha* Reuss, 1866, is also a living species.

This species differs from *Puellina simulator* in the presence of an oral mucro and in the constancy of the two oral avicularia on all the zooecia and not on ovicelled zooecia alone.

*Occurrence.*—Upper Jacksonian (Ocala limestone): Seven miles above Bainbridge, Georgia (very rare).

*Holotype.*—Cat. No. 64028, U.S.N.M.

### PUELLINA SIMULATOR, new species.

Plate 41, fig. 21; plate 84, fig. 14.

*Description.*—The zoarium incrusts shells, bryozoa, or Orbitoides. The zooecia are distinct, separated by a furrow, elongated, elliptical; the frontal is convex and formed of 20 to 24 thin costules separated by the very small lacunae and traversed by a line of small lumen pores. The aperture is semilunar, bordered by a peristome bearing four indistinct distal spines. The ovicelled zooecia bear two thin oral avicularia, placed longitudinally, the point above; in the junction angles of the zooecia without avicularia there are some thin avicularia a little longer than usual. The ovicell is imbedded in the distal zooecium, small, globular, improminent, and always closed by the operculum.

*Measurements.*—Aperture $\begin{cases} ha=0.04 \text{ mm.} \\ la=0.06 \text{ mm.} \end{cases}$ Zooecia $\begin{matrix} Lz=0.36\text{–}0.40 \text{ mm.} \\ lz=0.22 \text{ mm.} \end{matrix}$

*Affinities.*—This species simulates *Puellina calamorpha* Reuss, 1866, in its ovicelled zooecia ornamented with two avicularia. It differs from it in its semilunar aperture with neither mucro nor proximal convexity, in the larger number of its costules, and in the long avicularia placed in the junction angles of the non-ovicelled zooecia. These latter are much smaller (0.15 mm. and not 0.30 mm.) than the interzooecial avicularia of *Puellina radiata* Moll, 1803.

It differs from *Puellina bispinosa* in that the ordinary zooecia are deprived of avicularia and in the much smaller ovicell.

*Occurrence.*—Vicksburgian (Marianna limestone): One mile north of Monroeville, Alabama (rare); near Claiborne, Monroe County, Alabama (rare); west bank of Conecuh River, Escambia County, Alabama.

Jacksonian (Zeuglodon zone): Cocoa Post Office, Choctaw County, Alabama.

*Cotypes.*—Cat. Nos. 64027, 64259, U.S.N.M.

### PUELLINA INARMATA, new species.

Plate 84, fig. 15.

*Description.*—The zoarium incrusts Orbitoides and bryozoa. The zooecia are distinct, separated by a furrow, elongated, elliptical; the frontal is only slightly convex; the costules are fine, radial, separated by very small lacunae, and ornamented with a double row of very fine granules; there are nine or ten pairs; in the shield there is a very visible lumen pore. The aperture is semilunar, transverse, larger on the ovicelled zooecia, surrounded by a smooth peristome. The ovicell is imbedded in the distal zooecium, improminent, always closed by the operculum; very rarely there is a small, simple avicularium in the zooecial junction angles.

*Measurements.*—Aperture $\begin{cases} ha=0.03\text{–}0.04\text{ mm.} \\ la=0.06\text{ mm.} \end{cases}$ Zooecia $\begin{cases} Lz=0.36\text{ mm.} \\ lz=0.24\text{–}0.30\text{ mm.} \end{cases}$

*Affinities.*—The total absence of avicularia characterizes this species. However, sometimes on the peristome a very small pore is visible and again, in some of the zooecial junction angles there is a small, round, and simple avicularium.

The double row of small granules which ornament the costules also characterize this species; however, this character is inconstant and many of the zooecia have some costules sculptured as in *Puellina calamorpha Reuss.* This last species has two very constant, oral avicularia.

*Occurrence.*—Vicksburgian (Marianna limestone): Murder Creek, east of Castlebury, Conecuh County, Alabama (rare); west bank of Conecuh River, Escambia County, Alabama (rare).

*Holotype.*—Cat. No. 64260, U.S.N.M.

### Genus DISTANSESCHARELLA D'Orbigny, 1852.

1852. *Distansescharella* D'ORBIGNY, Paleontologie Française, Terrain Crétacé, Bryozoaires, p. 451.

In the interval which separates the zooecia there may be noted very small accessory cellules hardly a fourth the size of the others but of the same form. These smaller zooecia are always primoserial; there are always two or three of them following a preceding normal zooecium.

*Genotype.—Distansescharella* (*Cellepora*) *familiaris* Hagenow, 1839.

*Range.*—Senonian-Jacksonian.

### DISTANSESCHARELLA JACKSONICA, new species.

Plate 42, fig. 1.

Only the figured specimen has been found, and it is unfortunately very incomplete. The function of the thick smaller zooecia is unknown. Smitt has cited something analogous to them in *Membraniporella agassizi* Smitt, 1873,[1] where they are rare.

The zoarium incrusts an *Idmonea.*

*Occurrence.*—Middle Jacksonian: One-half mile southeast of Georgia Kaolin Company Mine, Twiggs County, Georgia (very rare).

*Holotype.*—Cat. No. 64029, U.S.N.M.

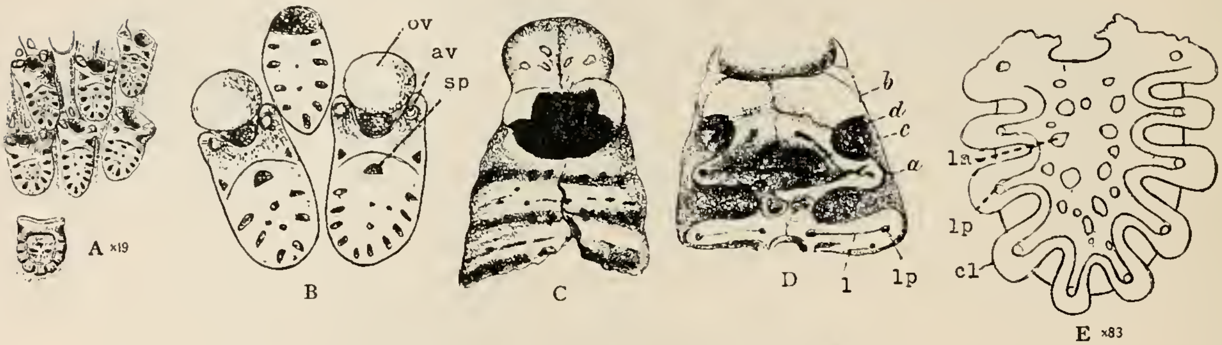

Fig. 85.—Genus *Gephyrotes* Norman, 1903.

A–E. *Gephyrotes nitido-punctata* Smitt, 1868. A. Zooecia, × 19. (After Smitt, 1868.) B. Zooecia, showing avicularia (*av*), ovicell (*ov*), and spiramen (*sp*). C. Var. *spitzbergensis* Norman, 1903. Anterior portion of an ovicelled zooecium. (After Norman, 1903.) D. The anterior portion of a zooecium, to show the structure of the bridge and oral opening. *a*, costula bifurcated; *b*, solid outspread costula; *c*, spiramen; *d*, lateral foramen; *l*, lumen; *lp*, lumen pore. E. Costular system, × 83. (After Nordgaard, 1903.) *cl*, loop of the costula; *la*, lacuna; *lp*, lumen pore.

### Genus GEPHYROTES Norman, 1903.

1903. *Gephyrotes* Norman, Notes on Natural History of East Finmark, Annals and Magazine Natural History, ser. 7 ,vol. 12, p. 100.

The costules are narrow. They are at first largely separated for half of their length; they are afterwards curved and join the adjacent costules, thus forming a complete arch; this arch is followed by large lateral lacunae. The two distal costules bifurcate to form a spiramen in the zooecial axis. A pair of avicularia with mandible pointing upwards is developed on the side walls of the aperture. The ovicell is subglobose and imperforated. No dietellae.

*Genotype.*—*Gephyrotes* (*Cribilina*) *nitido-punctata* Smitt, 1868.

*Range.*—Jacksonian-Recent.

We have classified in this genus all the Costulidae provided with a spiramen. But, under these conditions, all the costules are not identical. In their general aspect the various species of this genus have the aspect of the more typical *Galeopsis.* If the family *Galeopsidae* Canu, 1913, is natural, it may become necessary to include also the genus *Gephyrotes*, although at present we do not think so.

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[1] 1875, Smitt, Floridan Bryozoa, Svenska Vetenskaps-Akademiens Handlingar, vol. 19, p. 11, pt. 5, fig. 106.

### GEPHYROTES LEVIGATUM, new species.

Plate 6, figs. 1–4.

*Description.*—The zoarium incrusts shells. The zooecia are distinct, elongated, aliform; the frontal is a convex gymnocyst encircling a cribriform area formed of three or four pairs of costules without lateral median lacunae. All of the zooecia bear an oblique spiramen. The aperture is elliptical, transverse, surrounded by a thin, sharp peristome. The ovicell is embedded in the distal zooecia, rather large, *smooth*, and globular. The two oral avicularia are rather large; their point is directed toward the center of the aperture. One pair of lateral dietellae and a distal dietella are present.

*Measurements.*—Aperture $\begin{cases} ha = 0.06–0.07 \text{ mm.} \\ la = 0.10–0.12 \text{ mm.} \end{cases}$

Zooecia $\begin{cases} Lz = 0.40–0.45 \text{ mm.} \\ lz = 0.30–0.35 \text{ mm. (including avicularia).} \end{cases}$

*Variations.*—Our description agrees most with figure 1, which shows the general aspect of our specimens. We have illustrated two others (figs. 2 and 3) of a little different aspect. The gymnocyst is very small in figure 2; it is absent in figure 3; the costules are then larger. As the micrometric measurements, the avicularia, and the ovicells are identical, we have not created a new species for these less typical specimens.

There are no lateral lacunae. The costules seem to us to be those of *Membraniporella*, but we have not been able to discover their nature by a tangential thin section because of the rarity of the specimens. The presence of the dietellae would still be a reason for classifying the species in *Membraniporella.* However, the operculum appears to close the ovicell only when opening.

The patient collector who will secure a score of specimens of this species and of the following, will be sure of making important discoveries on the structure of the Costulae.

*Affinities.*—This species differs from *Gephyrotes saillans* in its less prominent peristome and in its oral avicularia, which are much smaller (*Lav* 0.15 mm. and not 0.25 mm.) and are lacking the calcareous pivot.

In its smooth ovicell, it differs from *Gephyrotes convexa* and from *Gephyrotes spectabilis.*

*Occurrence.*—Midwayan (Clayton limestone): One mile west of Fort Gaines, Georgia (rare).

*Cotypes.*—Cat. No. 63816, U.S.N.M.

### GEPHYROTES SAILLANS, new species.

Plate 5, figs. 18–20.

*Description.*—The zoarium creeps over algae. The zooecia are distinct, elongated, separated by a furrow, aliform; the frontal is a convex gymnocyst, encircling a small cribriform area formed of three or four pairs of costules, without lateral median lacunae. Many zooecia bear a spiramen. The aperture is elliptical. transverse, provided with a vestibular arch. and surrounded by a very *salient* peristome. The ovicell, embedded in the distal zooecium, is large, globular, improminent; it opens into a false peristome in front of the spiramen: it is closed by the operculum when the latter is open. The oral avicularia are very oblique, almost transverse, large (*Lav* 0.25 mm.), quite pointed, provided with a calcareous pivot, and directed toward the interior of the aperture.

*Measurements.*—Aperture $\begin{cases} ha=0.13 \text{ mm.} \\ la=0.15 \text{ mm.} \end{cases}$

Zooecia $\begin{cases} Lz=0.55\text{–}0.60 \text{ mm.} \\ lz=0.45 \text{ mm. (including avicularia).} \end{cases}$

*Variations and affinities.*—The spiramen is present on all the zooecia and is situated at the distal extremity of the cribriform area, nearly perpendicularly to the plane of the zooecia. It is necessary to incline the specimen preparation in order to see it clearly, and in our figures it has disappeared because of perspective.

This species differs from *Gephyrotes levigatum* in its very prominent peristome and its large avicularia (*Lav* 0.25 mm. and not 0.15 mm.). Like that species, it shows such undoubted resemblances with *Membraniporella* that further examination of numerous specimens is required. On the other hand, the presence of a spiramen seems to indicate that there is a compensatrix buried under the costules, as in *Figularia.*

In its smooth ovicell it differs from *Gephyrotes convexa* and from *G. spectabilis.*

*Occurrence.*—Midwayan (Clayton limestone): Luverne, Crenshaw County, Alabama (rare).

*Cotypes.*—Cat. No. 63814, U.S.N.M.

### GEPHYROTES CONVEXA, new species.

Plate 42, figs. 2, 3.

*Description.*—The zoarium incrusts Orbitoides. The zooecia are distinct, separated by a deep furrow, elongated, elliptical, distended; the frontal is very *convex* and consists of a small gymnocyst surrounding a cribriform area; this area is formed of six or seven pairs of thick costules closely united and decorated with at least two quite prominent lumen pores. The aperture is semilunar, transverse; the proximal border is somewhat concave, and the distal border bears four hollow spines. The ovarian zooecia alone bear the ovicell, the spiramen, and the oral avicularia. The ovicell is hyperstomial and little distinct. convex. transverse, bordered in front; it opens into the peristomie formed by the avicularia and the lamella which bears the spiramen; it is closed by the operculum at the moment the latter is opened. The two avicularia are very prominent, triangular, the point toward the proximal border of the aperture. The spiramen opens above the aperture. No dietellae.

*Measurements.*—Aperture $\begin{cases} ha=0.08 \\ la=0.10\text{–}0.12 \text{ mm.} \end{cases}$ Zooecia $\begin{cases} Lz=0.52\text{–}0.60 \text{ mm.} \\ lz=0.40\text{–}0.46 \text{ mm.} \end{cases}$

*Affinities.*—This species is very interesting in showing that the production of a peristomie and of a spiramen is a phenomenon in intimate connection with the passage of the eggs and the evacuation of the larvae. Jullien[1] believed that the spiramen was in relation with the opening of the operculum and consequently with the hydrostatic system. Here the operculum of the ordinary zooecia operates without a spiramen. The function of the latter therefore is problematical, indeed it may be only a pseudo-spiramen.

The characters of the species are the thick confluent costules and the fact that the ovicelled zooecia only are provided with a spiramen.

This species differs from *Gephyrotes saillans* in its more numerous and united costules and in the points of the avicularia which are directed backward.

*Occurrence.*—Upper Jacksonian (Ocala limestone): West bank of Sepulga River, Escambia County, Alabama (rare).

*Cotypes.*—Cat. No. 64030, U.S.N.M.

### GEPHYROTES SPECTABILIS, new species.

Plate 84, fig. 16.

*Description.*—The zoarium incrusts shells. The zooecia are distinct, elongated, elliptical, separated by very long interzooecial cavities. The frontal is convex and is formed of six pairs of widely separated costules. Each intercostular slit is followed by a lacuna; each costule bears a small but prominent lumen pore on the loop and a larger one at the other extremity. The first pair of costules bifurcates to surround the spiramen which opens obliquely above the aperture. The ovicell is embedded in the distal zooecia; it is globular, projecting, transverse, and bears in front a hollow collar; it opens into the peristomie formed by the avicularia and the prominent lamella which bears the spiramen. The two oral avicularia are quite prominent, triangular, oblique, the point directed toward the upper extremity of the zooecial median axis; provided with a calcareous pivot.

*Measurements.*—External aperture $\begin{cases} hp=0.08\text{–}0.10 \text{ mm.} \\ lp=0.10\text{–}0.12 \text{ mm.} \end{cases}$

Zooecia $\begin{cases} Lz=0.50\text{–}0.60 \text{ mm.} \\ lz=0.35\text{–}0.40 \text{ mm. (excluding avicularia).} \end{cases}$

*Variations.*—This *superb* species is perfectly characterized by its cribriform area. The lumen pore of the shield is frequently wanting. The two opposite lacunae are frequently joined to form a small transversal slit. The large interzooecial cavities are very irregular in form and size; it is impossible to consider them as avicularia and their function is therefore problematical.

The marginal zooecia shown in our figure appear to be of young zooecia; they are without spiramen and avicularia, and their aperture is transverse with a concave, proximal border. In the junction angles there is a minute pore, probably a small, simple avicularium.

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[1] 1903, Jullien, Bryozoaires provenant de campagnee *d'l'Hirondelle*, p. 74.

This species is somewhat like the *Cribrilina chelys* Koschinsky, 1885, of the Priabonian of the Vicentin. The latter, however, is provided with interzooecial avicularia.

We unfortunately possess only the figured specimen.

*Occurrence.*—Vicksburgian (Byram marl): Byram, Mississippi (very rare).

*Holotype.*—Cat. No. 64261, U.S.N.M.

### GEPHYROTES QUADRISERIALIS, new species.

Plate 42, figs. 4, 5.

*Description.*—The zoarium is free, cylindrical, bifurcated, formed of *four* longitudinal rows of zooecia opposed to each other, two by two. The zooecia are distinct, elongated, separated by a furrow. The frontal is very convex and formed of nine pairs of closely united costules. Each costule bears at least two lumen pores; the first pair bifurcates to form the spiramen and the peristomial lamella. The aperture is elliptical and transverse and buried at the bottom of the peristomice.

*Measurements.*—Zooecia $\left\{\begin{array}{l} Lz=0.65\text{–}0.75 \text{ mm.} \\ lz=0.40 \text{ mm.} \end{array}\right.$

*Affinities.*—The spiramen is not constant and is sometimes replaced by a pseudorimule cut at the middle of the lower lip of the peristomice.

As the spiramen is almost vertically placed, it is clearly visible only when the specimen is inclined: then, viewing it transversely, the proximal border of the aperture beneath it is quite visible. The lacunae are so small that they can not be shown in the figure.

The genus *Corbulipora* of MacGillivray also has quadriserial zoaria, but the zooecia have no spiramen.

The structure of the costules is identical with that in *Gephyrotes convexa;* but *G. quadriserialis* differs in its free and nonincrusting zoarium, in its nonovicelled zooecia bearing a spiramen, and in the entire absence of a zooecial gymnocyst.

The species under discussion is the equivalent of *Cribrilina crenatimargo-haueri* Reuss, 1847, of the Priabonian of the Vicentin, but differs from it in its quadriserial and not bilamellar zoarium and in the presence of the spiramen.

*Gephyrotes quadriserialis* furthermore has no oral avicularia and is of such an aberrant type that it will be convenient perhaps to separate it generically when the ovicell has been discovered.

*Occurrence.*—Upper Jacksonian (Ocala limestone): Chipola River, east of Marianna, Jackson County, Florida (rare).

*Cotypes.*—Cat. No. 64031, U.S.N.M.

### Genus METRACOLPOSA Canu and Bassler, 1917.

1917. *Metracolposa* Canu and Bassler, Synopsis of American Early Tertiary Cheilostome Bryozoa, Bulletin 96, United States National Museum, p. 34.

The costules are separated by numerous lacunae. The aperture is semilunar. The operculum in opening closes the ovicell. The ovicell is large and deeply embedded in the distal zooecia. The ovicelled zooecia have a large aperture.

*Genotype.*—*Metracolposa robusta* Canu and Bassler, 1917. Jacksonian.

This genus differs from *Cribrilina* Gray, 1848, in its opercular dimorphism. Moreover, the operculum probably closes the ovicell during the whole period of development of the embryo, as this is the habit in those species where the operculum closes the ovicell in opening. The ovicell occupies a large part of the distal zooecia, the capacity of which is thus much reduced. The lumen pores are scarcely visible, irregular, never prominent.

### METRACOLPOSA BREVIS, new species.

Plate 42, figs. 6, 7.

*Description.*—The zoarium is free, and bilamellar. The zooecia are large, elliptical, *short*. The frontal is little convex; the costules are triangular, radial, seven or eight pairs in number, separated by five or six lacunae concentrically arranged; no lumen pores. The aperture is transverse, semielliptical, bordered distally by a very thin incomplete peristome. The ovicell is enormous, globular, smooth, opening above the operculum but able to be closed by it. No avicularium.

*Measurements.*—Aperture $\begin{cases} ha=0.14 \text{ mm.} \\ la=0.28 \text{ mm.} \end{cases}$ Zooecia $\begin{cases} Lz=0.80\text{–}0.90 \text{ mm.} \\ lz=0.60\text{–}0.70 \text{ mm.} \end{cases}$

*Affinities.*—This very elegant species may be distinguished from *Metracolposa grandis* by its less length, greater width, the radial arrangement of the costules, and the absence of avicularia.

It differs from *Metracolposa robusta* in its greater width, its larger costules, and the absence of avicularia.

*Occurrence.*—Middle Jacksonian: Near Lenuds Ferry, South Carolina (rare); 18 miles west of Wrightsville, Johnson County, Georgia (rare).

*Holotype.*—Cat. No. 64032, U.S.N.M.

### METRACOLPOSA GRANDIS, new species.

Plate 42, figs. 8–13.

*Description.*—The zoarium is large, free, bilamellar. The zooecia are distinct, elongated, *large*, elliptical. The frontal is convex; the costules are thick, nearly transverse, little distinct, numbering from five to seven pairs and separated by large circular lacunae. The aperture is transverse, semielliptical, bordered distally by a very thin, incomplete, improminent peristome. The ovicell is very large, elongated, prominent, globose, perforated by small irregular pores and decorated in front by a large deltoid carina. A very large transverse oral avicularium above each aperture.

*Measurements.*—Aperture (ordinary) $\begin{cases} ha=0.14\text{–}0.24 \text{ mm.} \\ la=0.22\text{–}0.26 \text{ mm.} \end{cases}$ Aperture (ovicelled) $\begin{cases} ha=0.16 \text{ mm.} \\ la=0.36 \text{ mm.} \end{cases}$

Zooecia $\begin{cases} Lz=0.90\text{–}1.10 \text{ mm.} \\ lz=0.54\text{–}0.56 \text{ mm.} \end{cases}$

*Variations.*—The number of the costules is rather variable; they are arranged horizontally at the top and radially below. The lumen pores are sometimes visible (fig. 9); they are irregularly placed and never prominent.

There are sometimes two distal avicularia (fig. 9); their points touch above the aperture on the median zooecial axis; there are some zooecia unprovided with avicularia (fig. 9).

In the interior (fig. 10) the proximal border of the aperture is bordered by a thick collar. The avicularia are interzooecial.

The margins of the costules are invisible in tangential section (fig. 12); the lumen pores are visible, but not the lumen itself. In figure 12 the lacunae are seen to be surrounded by a polygonal network, which indicates the boundary of the primitive spines.

*Affinities.*—This species differs from *Metracolposa brevis* in the presence of large distal avicularia and in its greater zooecial length, and from *Metracolposa robusta* in its larger zooecia and its much larger and more numerous avicularia. On account of the size of its zoarium this is an easily recognized fossil.

*Occurrence.*—Middle Jacksonian: Wilmington, North Carolina (common); near Lenuds Ferry, South Carolina (common).

*Holotype.*—Cat. No. 64033, U.S.N.M.

### METRACOLPOSA ROBUSTA Canu and Bassler, 1917.

Plate 43, figs. 1–7.

1917. *Metracolposa robusta* CANU and BASSLER, Synopsis of American Early Tertiary Cheilostome Bryozoa, Bulletin 96, United States National Museum, p. 35, pl. 3, fig. 6.

*Description.*—The zoarium is free, bilamellar, large (1 to 2 centimeters in width), solid, *robust.* The zooecia are distinct, elongated, elliptical; the frontal is somewhat convex; the costules are transverse at the top, radial below; they number from seven to nine pairs and are separated by four or five large lacunae; the lumen pores are small and irregular. The aperture is transverse, semielliptical with a straight or slightly convex proximal border; it is bordered distally by a very thin, incomplete peristome. The ovicell is large and deeply embedded in the distal zooecia, elongated, salient, convex, decorated in front with a deltoid carina; it opens above the aperture and probably was closed by the operculum when it opened. The aperture of the ovicelled zooecia is larger. A small, triangular distal avicularium is placed either on the right or left of the aperture.

*Measurements.*—Aperture (ordinary) $\begin{cases} ha=0.10\text{ mm.} \\ la=0.20\text{ mm.} \end{cases}$

Aperture (ovicelled) $\begin{cases} ha=0.12\text{–}0.14\text{ mm.} \\ la=0.28\text{–}0.30\text{ mm.} \end{cases}$

Zooecia $\begin{cases} Lz=0.96\text{–}1.00\text{ mm.} \\ lz=0.44\text{–}0.46\text{ mm.} \end{cases}$

*Variations.*—The zooecial width is rather variable; there are some zooecia which measure 0.51 mm., in which case the costules are radially arranged (fig. 2).

The avicularia are rather rare; their point is directed toward the median axis of the zooecia above the aperture; sometimes they are vertical; when well preserved they have a calcareous pivot.

In the interior (fig. 7) the ovicell is seen to occupy the larger part of the cavity of the distal zooecia—a condition which is better visible on the vertical section (fig. 5). This section also permits one to understand the movements of the operculum. This structure closes the ovicell at the moment of the passage of the eggs and during the evolution of the embryos. After the expulsion of the latter it closes only that zooecium in which the aperture has preserved its distal but deeply buried margin.

In thin section the zooecial walls are thin, and composed of scattered olocystal elements. The avicularia appear to be interzooecial.

It may be that the costules are not hollow, for the lumen has never been observed.

The two lamellae forming the zoarium are inseparable.

There are four or five lateral septulae (fig. 6).

*Affinities.*—*Metracolposa robusta* differs from *Metracolposa brevis* in the presence of an avicularium and in its smaller zooecial width.

It differs from *Metracolposa grandis* in its smaller general dimensions and its much smaller and rare avicularia, and from *Metracolposa cylindrica* in its bilamellar zoarium.

The zoarial dimensions are such that this is a good-sized fossil and easily recognized.

*Occurrence.*—Middle Jacksonian: Wilmington, North Carolina (very common); Eutaw Springs, South Carolina (rare).

*Cotypes.*—Cat. No. 62586, U.S.N.M.

### METRACOLPOSA CYLINDRICA, new species.

Plate 42, figs. 14–20.

*Description.*—The zoarium is free, *cylindrical*, formed of six rows of zooecia. The zooecia are distinct, much elongated, elliptical; the frontal is convex; the costules are thick, numbering eleven or twelve pairs, separated by four or five rather large lacunae, without lumen pores. The aperture is transverse, semielliptical, with a straight or slightly concave proximal border. The ovicell is very large, embedded in the distal zooecium, elongated, prominent, convex, decorated in front with a deltoid carina; the ovicell opens above the aperture and probably was closed by the operculum. The avicularia are triangular and are placed in the junction angles of the zooecia; their point is turned toward the median axis of the zooecia.

*Measurements.*—Aperture (ordinary) $\begin{cases} ha=0.10\text{–}0.14 \text{ mm.} \\ la=0.16\text{–}0.18 \text{ mm.} \end{cases}$ Aperture (ovicelled) $\begin{cases} ha=0.17 \text{ mm.} \\ la=0.35 \text{ mm.} \end{cases}$

Zooecia $\begin{cases} Lz=1.10\text{–}1.20 \text{ mm.} \\ lz=0.40\text{–}0.42 \text{ mm.} \end{cases}$

*Variations.*—The distal avicularia are inconstant; they are sometimes attenuated (fig. 16) and even absent (fig. 18).

The keel of the ovicell, very clear in figure 17, is much attenuated in figure 15.

We have observed (fig. 17) an aperture closed by a calcareous operculum. This phenomenon is frequent in all the Cheilostomes, but as yet zoologists have not learned its significance.

Certain zoaria are narrow at their lower extremity (fig. 18) as if they were formed of segments for articulation. The base of such segments (fig. 20) bears three pores, which is not the case in articulated·zoaria.

The zooecial walls (fig. 19) are very thin. The ovicell occupies a portion of the cavity of the distal zooecia. As in the other species of the same genus the costules are apparently not hollow.

*Affinities.*—This species is distinguished from all others of the genus by its cylindrical zoarium, but it is very close to *Metracolposa robusta* of which it might be a variety if we had intermediate forms. It differs from the latter in having a larger number of costules, in the presence of two larger distal avicularia and in the smaller zooecial breadth, and from *Metracolposa grandis* in its much smaller lacunae and its very different micrometrical dimensions.

*Occurrence.*—Middle Jacksonian: Wilmington, North Carolina (common); near Lenuds Ferry, South Carolina (very common).

*Cotypes.*—Cat. No. 64034, U.S.N.M.

### Genus CORBULIPORA MacGillivray, 1895.

1895. *Corbulipora* MacGillivray, Monograph Tertiary Polyzoa Victoria, Transactions Royal Society Victoria, vol. 4, p. 60.

"Zoarium erect, zooecia quadriserial, facing to the four sides, much elongated, calcareous, readily separating longitudinally. Anterior part wider, raised, formed by a series of vertical ribs on each side, turning abruptly inwards and uniting to form a flat plate; posterior part of zooecia narrow, smooth, and entire; thyrostome with the upper lip arched, thickened, and smooth." (MacGillivray.)

*Genotype.*—*Corbulipora ornata* MacGillivray, 1895.

*Range.*—Eocene-Miocene.

This genus is purely zoarial. The figures given by MacGillivray are incomplete. Two specimens that have been sent to us by Mr. Maplestone are somewhat different from MacGillivray's description. The costules have lumen pores; the initial slit separating two costules is very small. The genus has the costular structure of *Gephyrotes*.

### CORBULIPORA COLLARIS, new species.

Plate 43, fig. 14.

*Description.*—The zoarium is free, quadriserial, bifurcated. The zooecia are distinct, separated by a prominent thread or a furrow, and are much elongated, elliptical; the frontal is convex; the costules are fine, numerous, ornamented with very small lumen pores; separated by a large, initial slit, followed by two lacunae; the superior costules are more or less united to form a sort of collar. The aperture is semilunar; the distal part is bordered by a very thin, incomplete peristome. There are one or two small, triangular, transverse, oral avicularia touching each other at their tips.

*Measurements.*—Aperture $\begin{cases} ha=0.05 \text{ mm.} \\ la=0.11 \text{ mm.} \end{cases}$ Zooecia $\begin{cases} Lz=0.60 \text{ mm.} \\ lz=0.30 \text{ mm.} \end{cases}$

*Affinities.*—All of the zooecia are not provided with the characteristic *collar* which arises from the more or less complete union of the first three pairs of costules. The number of pairs of costules varies from 12 to 17.

Only a few specimens have been found, none of which shows an ovicell. The quadriserial zoarium and the costules with lumen pores are the only reasons we have for classifying this species in *Corbulipora*, a genus which must be considered as inadequately described.

*Occurrence.*—Middle Jacksonian (Castle Hayne limestone): Wilmington, North Carolina (rare).

*Holotype.*—Cat. No. 64035, U.S.N.M.

### Genus ACANTHOCELLA Canu and Bassler, 1917.

1917. *Acanthocella* Canu and Bassler, Synopsis of American Early Tertiary Cheilostome Bryozoa, Bulletin 96, United States National Museum, p. 35.

The costules bear a row of very prominent lumen pores and are separated by lacunae of greater or less size. The aperture is semilunar. The ovicell is hyperstomial and its orifice is not in contact with the operculum.

*Genotype.*—*Cribrilina tubulifera* Hincks, 1881, from Australian seas.

*Range.*—Jacksonian-Recent.

### ACANTHOCELLA ERINACEA Canu and Bassler, 1917.

Plate 43, figs. 10–13.

1917. *Acanthocella erinacea* Canu and Bassler, Synopsis of American Early Tertiary Bryozoa, Bulletin 96, United States National Museum, p. 36, pl. 4, fig. 1.

*Description.*—The zoarium incrusts shells and bryozoa or creeps over algae. The zooecia are distinct, very slightly elongated, subcircular; the frontal is very convex; the costules are thick, separated by the lacunae and ornamented by three very prominent, hollow spines corresponding to the lumen pores. The aperture is semilunar with a straight proximal border; the peristome is distal and bears four large, hollow spines. The ovicell is hyperstomial, buried in the distal zooecia, globose, not closed by the operculum, ornamented with small, remote punctations.

*Measurements.*—Aperture $\begin{cases} ha=0.09 \text{ mm.} \\ la=0.11\text{–}0.12 \text{ mm.} \end{cases}$ Zooecia $\begin{cases} Lz=0.75\text{–}0.80 \text{ mm.} \\ lz=0.50\text{–}0.65 \text{ mm.} \end{cases}$

*Variations.*—The sharp points which decorate this species give it the spinous aspect of a *hedgehog*. It is very variable in its micrometer dimensions and its gemmation; the zooecia are oriented in the most unexpected and divergent manner. The costules are separated first by an initial slit (fig. 13) hidden and almost vertical, and are followed by large (fig. 10) or smaller (figs. 11, 13) lacunae, which vary in number, although there are always at least two.

The tangential sections show very clearly the existence of a lumen and of large lumen pores (fig. 12).

*Affinities.*—This species differs from the recent *Acanthocella tubulifera* Hincks, 1881, in its larger number of lumen pores (3 or 4 instead of 2).

It differs from *Cribrilina suggerens* Waters, 1881, in its zoarium, which is not bilamellar and in its larger micrometric dimensions (*la*=0.12 mm. and not 0.06 mm.).

*Occurrence.*—Middle Jacksonian (Castle Hayne limestone) : Wilmington, North Carolina (rare).

*Cotypes.*—Cat. No. 62587, U.S.N.M.

### Genus CRIBRENDOECIUM Canu and Bassler, 1917.

1917. *Cribrendoecium* Canu and Bassler, Synopsis of American Early Tertiary Cheilostome Bryozoa, Bulletin 96, United States National Museum, p. 36.

The ovicell is endozooecial. The costules are separated by a small initial slit and some medium-sized lacunae; they have no lumen pores. The aperture is formed of a semilunar anterior portion and a larger and concave posterior part separated by two cardelles. The aperture of the ovicelled zooecia is larger. Large interzooecial avicularia are present.

*Genotype.*—*Cribrendoecium tenuicostulatum* Canu and Bassler, 1917.

This genus shows the closest resemblance to *Hippopodina* Levinsen, 1909, in the nature of its ovicell and its oral dimorphism. On the other hand, its interzooecial avicularia and the structure of its ovicell marked with two lateral cicatrices, relate it to *Figularia* Jullien, 1880. It is therefore very probable that the species of *Cribrendoecium* are provided with a compensatrix, just as in the two genera cited and as the nature of its aperture would predict.

#### CRIBRENDOECIUM TENUICOSTULATUM Canu and Bassler, 1917.

Plate 43, fig. 8.

1917. *Cribrendoecium tenuicostulatum* Canu and Bassler, Synopsis of American Early Tertiary Cheilostome Bryozoa, Bulletin 96, United States National Museum, p. 36, pl. 4, fig. 1.

*Description.*—The zoarium incrusts shells. The zooecia are distinct, elongated, separated by a furrow, elliptical, fusiform; the frontal is convex; the costules are very *thin*, numerous, without lumen pores, and separated by very small lacunae. The apertures of the ordinary zooecia are formed of a semilunar anterior and a very large, straight posterior part separated by two small cardelles; the aperture of the ovicelled zooecia is larger and its posterior portion is convex. The ovicell is endozooecial and exteriorly is prominent and transverse; it is formed of two calcareous deposits; the outer one is incomplete and leaves two lateral cicatrices in the form of a cross. The avicularia are interzooecial and are elongated, spatulate, perforated by a long slit and generally without pivot.

*Measurements.*—Ordinary aperture $\begin{cases} ha=0.09 \text{ mm.} \\ la=0.11 \text{ mm.} \end{cases}$

Ovicelled aperture $\begin{cases} ha=0.10 \text{ mm.} \\ la=0.13 \text{ mm.} \end{cases}$

Zooecia $\begin{cases} Lz=0.50\text{–}0.60 \text{ mm.} \\ lz=0.25\text{–}0.35 \text{ mm.} \end{cases}$

*Affinities.*—The discovery of a member of the Cribrilinidae provided with an endozooecial ovicell is very important, as it indicates clearly that the structure of the frontal has no connection with the various organs (ovarian) of the polypide. At the same time the presence of the costules does not imply the muscular system of the Anasca, since the form of the aperture indicates a characteristic compensatrix of the Ascophora; this frontal has no connection with the hydrostatic system.

The costular structure has no special function, being only a decoration or, to be exact, an adaption for a particular purpose, and it can not be employed to characterize a natural family.

This species must not be confounded with any species of the genus *Figularia* Jullien, which is provided with a hyperstomial ovicell.

*Occurrence.*—Middle Jacksonian (Castle Hayne limestone): Wilmington, North Carolina (rare).

*Holotype.*—Cat. No. 62588, U.S.N.M.

### Genus ARACHNOPUSIA Jullien, 1886.

*Bibliography* (*Anatomical*).—1881. Hincks, Contribution toward a general History of the Marine Polyzoa, Annals Magazine Natural History, ser. 5, vol. 8, p. 57, pl. 3, fig. 6.—1884. Hincks, Contribution toward a general History of Marine Polyzoa, Annals Magazine Natural History, ser. 5, vol. 4, p. 129, pl. 8, fig. 5.—1884. Busk, Report on the Scientific Results of the Voyage of the *Challenger*, pt. 1, Cheilostomata, vol. 10, pt. 30, p. 133, pl. 19, fig. 8.—1887. Waters, Bryozoa from New South Wales, North Australia, Annals Magazine Natural History, ser. 5, vol. 20, p. 187, pl. 6, fig. 7.—1888. Jullien, Mission scientific du Cap Horn, vol. 6, Zoology, Bryozoaires, p. 63, pl. 3, figs. 8, 9.—1906. Waters, Bryozoa from Chatham Island, Annals Magazine Natural History, ser. 7, vol. 17, p. 16, pl. 1, fig. 11.

The cribriform area is formed by the coalescence of hollow branched spines attached to the lateral walls. The lacunae are concentrically arranged and semilunate with an interior denticule. The opercular valve is membranous. The ovicell is hyperstomial and opens into a small peristomie above the operculum; it is closed by a special operculum and is formed by a double calcareous deposit. The lateral walls have septular disks with 1 to 3 pores; the distal walls bear only septules; 17 tentacles.

*Genotype.*—*Arachnopusia* (*Lepralia*) *monoceros* Busk, 1854.

*Range.*—Vicksburgian-Recent.

#### ARACHNOPUSIA VICKSBURGICA, new species.

Plate 85, figs. 1–3.

*Description.*—The zoarium incrusts shells. The zooecia are distinct, separated by a furrow, at the bottom of which there are some small, elliptical, wide pores;

the frontal is convex, formed of calcareous polygonal pieces perforated by a large pore; each pore is semilunate and has an interior denticle; the convex side of this pore is turned toward the exterior, but the denticle is directed toward the zooecial axis; the cribriform area is surrounded by a smooth collar, composed of adjacent polygonal pieces. The aperture is elongated and formed of a semilunar anter and a concave poster without cardelles; the peristome is salient, smooth, and bears a distal lip, very prominent and oblique, and an acute, proximal mucro. The ovicell is hyperstomial, opening in the peristomie above the operculum; its ooecial cover is formed of various rectangular, calcareous pieces. A large elliptical avicularium is placed near the aperture.

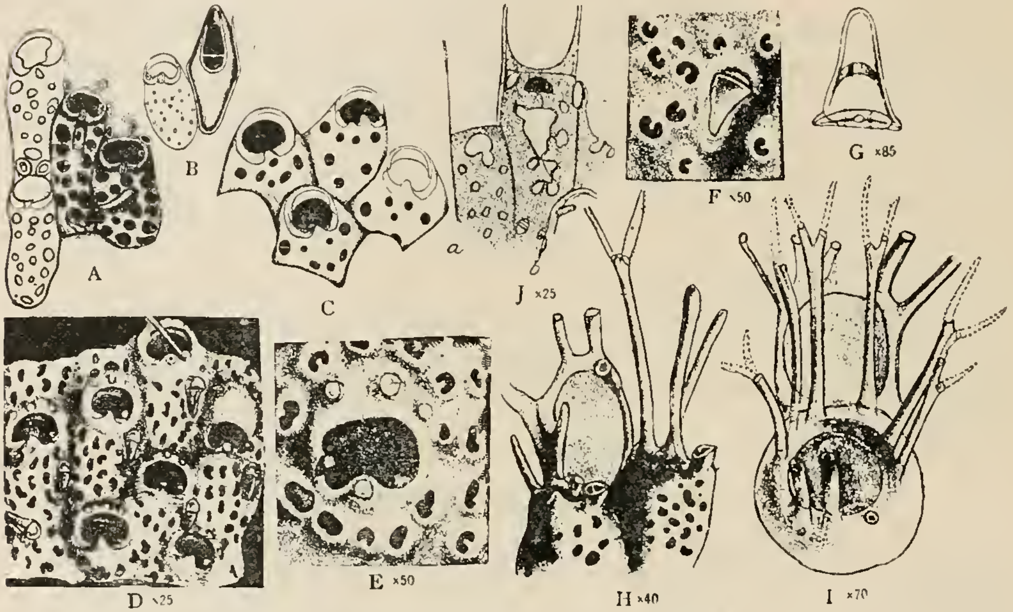

Fig. 86.—Genus *Arachnopusia* Jullien, 1886.

A–J. *Arachnopusia monoceros* Busk, 1854. A, B. Zooecium and one of the large marginal avicularia. (After Hincks, 1881.) C. Young cells. (After Hincks, 1884.) D. Zooecia, × 25. E. Orifice of zooecium, × 50. F. Immersed avicularium, × 50. (D–F after Busk, 1884.) G. Avicularian mandible, × 85. (After Waters, 1887.)

H. Young zooecia, × 40, bearing two or three marginal spines. There are other colonies of zooecia which have four of them. These marginal spines disappear promptly, except that one which is nearest the posterior lip of the orifice, and whose base alone persists; it is from the base of the spine that the species derives its name. The avicularian cavity forms here in great relief, and its circumference must soon increase on account of the calcareous deposit. (After Jullien, 1886.) I. Ancestrula, × 70, with a young zooecium with five spines. (After Jullien, 1886.) J. Growing ends, × 25, showing the calcareous projections arising from the side, thus forming pores. In the left-hand zooecium (*a*) the lower calcareous wall below the oral aperture is not complete. Above the zooecia (distally) the basal and lateral walls are found before there is any other sign of growth, and in the division thus formed above the right-hand zooecium the calcareous front wall is commencing and has made a semicircular growth. Between the zooecium *a* and *b* there was another, but this has been omitted. (After Waters, 1906.)

*Measurements.*—Aperture $\begin{cases} ha=0.15 \text{ mm.} \\ la=0.15 \text{ mm.} \end{cases}$ Zooecia $\begin{cases} Lz=0.65\text{–}0.72 \text{ mm.} \\ lz=0.35 \text{ mm.} \end{cases}$

*Variations.*—The structure of this species is quite remarkable. The lacunae are transformed into true areolae serving for the passage of the mesenchyme fibers, and of the endocyst, which is situated under the ectocyst; the endocyst continues its calcareous secretion over each areola and carves out a great number of polygonal pieces on each zooecium.

The smooth collar which surrounds the cribriform area is formed of as many pieces as it has areolae and covers the shield of the primitive costules.

The ooecial cover is composed of many calcareous pieces arising from as many pores of the distal zooecia and even the adjacent zooecia; nevertheless, the frontal arch terminated by two lateral appendages seems to have an exterior origin. This activity of calcareous secretion about each areola is very remarkable and tangential sections of the living *Arachnopusia monoceros* would be of great interest.

The mucro is not at all constant; it is replaced in the nonovicelled zooecia by a calcareous thickening bearing a cicatrix. Its development appears therefore according to rule to be in connection with the formation of a peristomie and with the passage of the eggs in the ovicell.

*Affinities.*—This species differs from *Arachnopusia* (*Cribrilina*) *terminata* Waters in its zoarium, which is incrusting and not free; in its much smaller oral dimensions (0.15 mm. and not 0.25 mm. by 0.14 mm.): and in the presence of larger avicularia.

The affinities of the Tertiary fauna of the American Gulf region are greatest with that of Europe, but in *Arachnopusia* we have a genus which has been observed in the fossil state only in the Southern hemisphere, chiefly in the Australian deposits. This single example is insufficient to prove communication with the Pacific of the American Tertiary Gulf, for the study of the Eocene deposits of the Pacific is still to be made. *Arachnopusia monoceros* Busk, 1854, was discovered recently in Florida waters at the Tortugas by Osburn.

*Occurrence.*—Vicksburgian (Byram marl): Byram, Mississippi (rare); one-fourth mile west of Woodward, Wayne County, Mississippi (rare).

*Holotype.*—Cat. No. 64262, U.S.N.M.

### Genus **FIGULARIA** Jullien, 1886.

1886. *Figularia* Jullien, Les Costulidies, Bulletin de la Société Zoologique de France, vol. 77, p. 608. (*Figulina* Levinsen, 1909.)

*Bibliography* (*Anatomical*).—1888. Jullien, Du testicule chez Lepralia figularis Memoires Société Zoologique France, p. 2, pl. 10, figs. 1, 2.—1902. Harmer, On the Morphology of the Cheilostomata, Quarterly Journal Microscopical Science, vol. 46, p. 292, pl. 15, figs. 8, 9.—1903. Norman, Notes on the Natural History of East Finmark, Annals Magazine Natural History, ser. 7, vol. 12, p. 98, pl. 9, fig. 7.—1887. Waters, Bryozoa from New South Wales, Annals Magazine Natural History, ser. 5, vol. 20, p. 187, pl. 6, fig. 1.—1889. Waters, Bryozoa from New South Wales, Annals Magazine Natural History, ser. 6, vol. 4, p. 5, pl. 1, figs. 6–9.

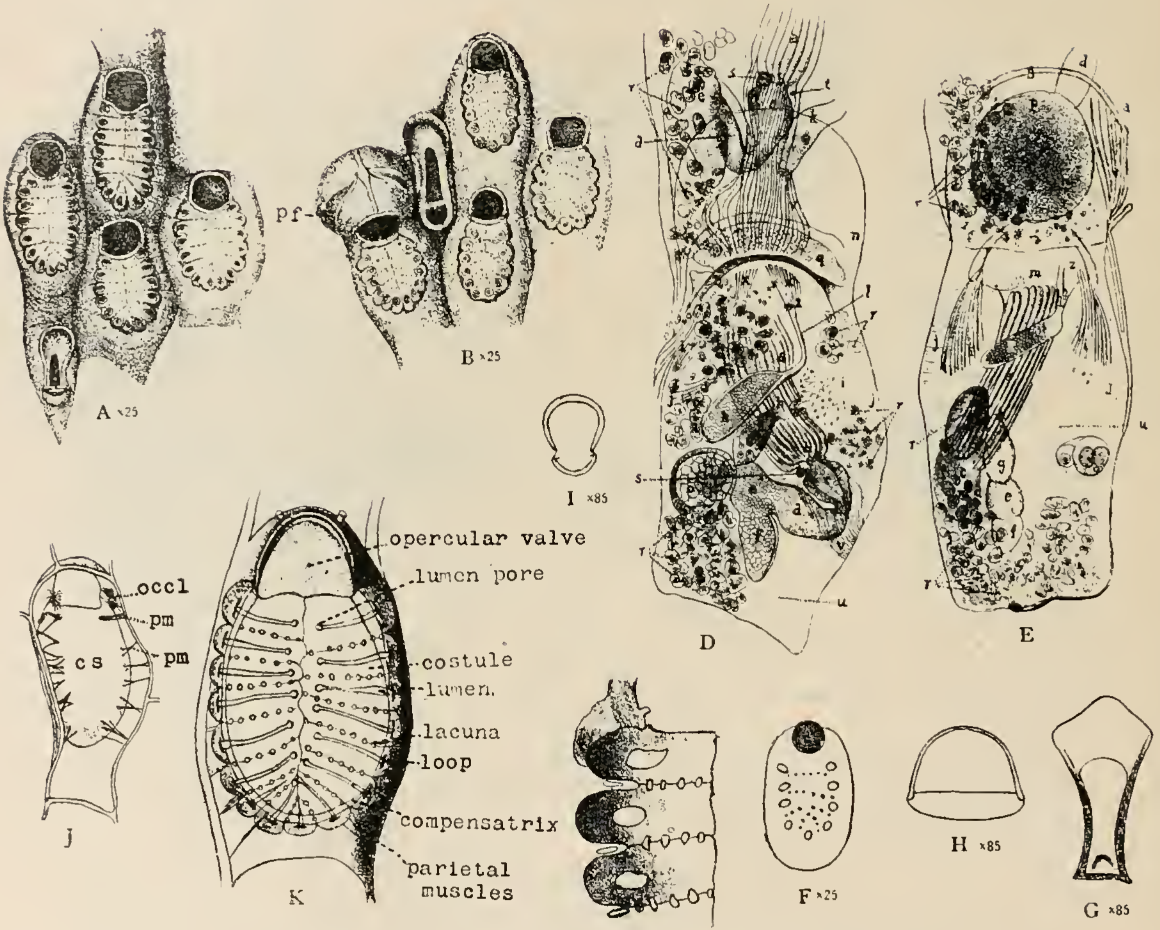
A ×25
B ×25
pf
D
E
I ×85
opercular valve
lumen pore
costule
lumen
lacuna
loop
compensatrix
parietal muscles
occl
pm
pm
cs
J
K
C
F ×25
H ×85
G ×85

Fig. 87.—Genus *Figularia* Jullien, 1886.

FIG. 87.—Genus *Figularia* Jullien, 1886.

A–F. *Figularia figularis* Johnston, 1847. A, B. Zooecia and avicularia, × 25. (After Hincks, 1880.) *pf*, pyriform fossa of Hincks=wide stigma of Busk. C. Detail of costules. (After Norman, 1903.) D, E. Two zooecia seen on the dorsal face, exhibiting the internal structure of their contents. (After Jullien, 1886.) In fig. D the testicle is still without spermatozooids; the ovary possesses an egg already in process of development; at the base of the ovicell is seen an epithelial covering. In fig. E the testicle contains spermatozooids, indicated by very fine lines; the ovary contains three nonfertile ovules, and the ovicell a larva or an egg in full development. *a*, lophophore in the tentacular sheath; *b*, mouth; *c*, pharynx; *d*, esophagus; *e*, stomach; *f*, gastric caecum; *g*, intestine; *h*, anus; *i*, retractor muscles of the operculum; *j*, parietal muscles; *k*, testicle; *l*, deferent canal; *m*, irisoid (obturator diaphragm of the tentacular sheath); *n*, ovicell; *o*, ovary; *p*, egg in process of development (larva); *q*, epithelium of the base of the ovicell; *r*, pseudo-cellular débris of the *brown body*, sometimes containing diatoms and radiolaria; *s*, brain (so-called esophagal ganglion); *t*, cervical nerve; *u*, cellular tissue, under the abdominal wall; *v*, rectractor muscles of the polypide; *x*, folds of the tentacular sheath; *z*, orifice of the ejaculatory canal on the irisoid. F. A zooecium decalcified, × 25. (After Waters, 1889.)

G–I. *Figularia clithridiata* Waters, 1887. G. Avicularian mandible, × 85. H. Operculum of ovicelligerous zooecium, × 85. I. Operculum of ordinary zooecium, × 85. (G–I after Waters, 1887.)

J, K. *Figularia philomela* Busk, 1884. J. Basal view of the zooecium. The distal parietal muscles *pm'* are stronger than the other groups *pm*. *cs*, compensatrix; *occl*, occlusor muscles. K. Zooecium illustrating terminology. The frontal shield is composed of hollow calcareous costulae, alternately arranged on the two sides of the zooecium. The rows of pores correspond with the intervals between the costulae. The compensatrix and some of the parietal muscles are indicated. (After Harmer, 1902.)

The costules are bound together by the intercostal cross pieces, producing at the bottom of the intercostal spaces a line of lacunae; each costule is provided at its talon with a large lumen pore. The aperture is formed of an anterior part and posterior part separated by two cardelles; it is closed by a wholly chitinized compound operculum. The ovicell is hyperstomial; it is provided with a median suture and with at least two pear-shaped perforations. The avicularia are interzooecial. No dietellae.

*Genotype.*—*Figularia* (*Lepralia*) *figularis* Johnston, 1847.

*Range.*—Jacksonian-Recent.

The species of this genus are:

*Figularia* (*Lepralia*) *figularis* Johnston. 1847.

*Figularia* (*Hemeschara*) *philomela* Busk. 1884.

*Figularia* (*Cribrilina*) *clithridiata* Waters. 1887.

In the last the aperture of the ovicelled zooecia is very large.

Levinsen believed that this genus had some relationship with the *Membranipora pyrula* group. Its operculum and its compensatrix approach moreover *Hippoporina*, which is a true member of the *Ascophora.*

It is doubtful whether this genus is represented in the Eocene of the United States, but as it is the only one of which the anatomy has been studied, we have illustrated it in some detail.

The oral glands so often described by Waters are here the testicular glands (Jullien).

### FIGULARIA (?) CRASSICOSTULATA, new species.

Plate 43, fig. 9.

*Description.*—The zoarium incrusts shells. The zooecia are little elongated, wide, elliptical, separated by a furrow; the frontal is convex; the costules are *thick*, transverse, separated by a small initial slit followed by two or three lacunae, in number from 8 to 10 pairs. The aperture of the ordinary zooecia is formed of an anter much arched and a poster a little wider and nearly straight, separated by two small cardelles; the peristome bears laterally two small tuberosities; the aperture of the ovicelled zooecia is larger and transverse. The ovicell is hyperstomial and exteriorly very convex; it is formed of two calcareous deposits, of which the outer one is incomplete, and leaves two cicatrices in the form of a crescent. The avicularium is interzooecial and large and wide.

*Measurements.*—Ordinary aperture $\begin{cases} ha=0.08 \text{ mm.} \\ la=0.10 \text{ mm.} \end{cases}$

Ovicelled aperture $\begin{cases} ha=0.10 \text{ mm.} \\ la=0.15 \text{ mm.} \end{cases}$

Zooecia $\begin{cases} Lz=0.73 \text{ mm.} \\ lz=0.30\text{–}0.40 \text{ mm.} \end{cases}$

*Affinities.*—This species differs from *Cribrendoecium tenuicostulatum* in the greater size of its costules and in its hyperstomial ovicell. There is no pore on the shield of the costules as in all the other species of this genus.

*Occurrence.*—Upper Jacksonian (Ocala limestone): Chipola River, east of Marianna, Jackson County, Florida (very rare); Old Factory, 1½ miles above Bainbridge, Georgia (very rare).

*Holotype.*—Cat. No. 64036, U.S.N.M.

### Genus ASPIDELECTRA Levinsen, 1909.

*Bibliography (Zoological).*—1903. Norman, Notes on the Natural History of East Finmark, Annals Magazine Natural History, ser. 7, vol. 12, pl. 8, fig.—1909. Levinsen, Morphological and Systematic Studies Cheilostomatous Bryozoa, pl. 160.

"The proximal part of the zooecium with one or two thick, projecting, hollow spines; the frontal shield perforated by slits; each distal wall with two multiporous septular disks, and the distal half of each lateral wall with a single septula, the aperture in the frontal shield with an opercular valve; no avicularia; no ovicell." (Levinsen.)

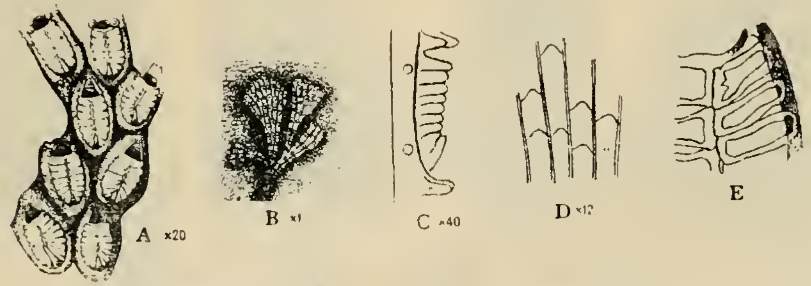

Fig. 88.—Genus *Aspidelectra* Levinsen, 1909.

A–E. *Aspidelectra melolontha* Busk, 1852. A, B. Zooecium, × 20, and zoarium, natural size. (After Hincks, 1880.) C. Lateral view of a zooecium, × 40. D. Lower side of the zoarium, × 12. (C, D after Levinsen, 1894.) E. Structure of the costules. (After Norman, 1903.)

*Genotype.*—*Aspidelectra* (*Lepralia*) *melolontha* Busk, 1852.

Levinsen thought that this genus belonged to the Electrinidae. It is not represented in the American Eocene, and we cite it to show how heterogeneous the Cribrilinidae are, and to suggest the importance of the ontogenetic works which might be undertaken on this subject.

## Family ACROPORIDAE Canu, 1913.

The zooecia are indistinct and their frontal is thickened. The ascopore, perforating the frontal, opens into the zooecia below the operculum. The ovicell is hyperstomial, deeply immersed and invisible exteriorly. The apertura is buried at the bottom of a long peristomie. There are some frontal avicularia and some peristomial avicularia.

The characteristics of this family are not yet sufficiently studied; the recent specimens are rare and the sections made of the fossil forms are often difficult to interpret.

We are able to distinguish the principal genera only by the nature of their frontal.

Following the Membraniporae, these are the most ancient Cheilostome fossils known.

### Genus ACROPORA Reuss, 1869.

1869. *Acropora* Reuss, Die fossilen Anthozoen und Bryozoen der Schichtengruppe von Crosaro, Denkschriften der k. Akademie der Wissenschaften, Wien, vol. 29, p. 277.

The zoarium is free and escharian. The frontal is a thick tremocyst with tubules. The avicularia are grouped on the peristome.

*Genotypes.*—*Acropora* (*Eschara*) *gracilis* Milne Edwards, 1836, of the Australian seas and *Acropora* (*Cellaria*) *coronata* Reuss, 1847, a fossil of the Vicentin.

*Range.*—Jacksonian-Recent.

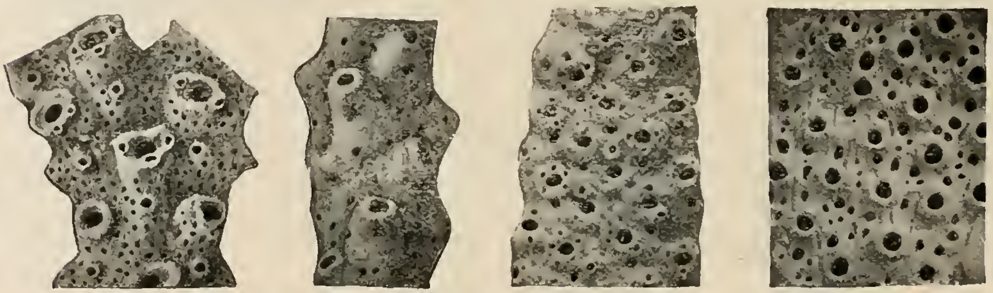
A. Acropora. B. Gastropella. C. Pachytheca. D. Beisselina.

Fig. 89.—Genera of the family Acroporidae Canu, 1913.

A. *Acropora saillans*, new species, × 20. Vicksburgian, 1 mile north of Monroeville, Alabama.
B. *Gastropella ventricosa* Canu and Bassler, 1917, × 20. Midwayan of Arkansas.
C. *Pachytheca stipata*, new species, ×20, Midwayan, Crenshaw County, Alabama.
D. *Beisselina trulla*, new species, × 20. Lower Jacksonian, Jackson, Mississippi.

The known species of this genus are:

*Acropora* (*Eschara*) *coronata* Von Hagenow, 1851 (not Reuss). Maestrichtian.
*Acropora* (*Cellaria*) *coronata* Reuss, 1847. Priabonian.
*Acropora* (*Entalophora*) *grateloupi* D'Orbigny, 1851. Lutetian.
*Acropora* (*Porina*) *contorta* Canu, 1910. Auversian.
*Acropora* (*Pustulipora*) *mamillata* D'Archiac, 1846. Auversian.
*Acropora* (*Eschara*) *gracilis* Milne Edwards, 1836. Recent.

#### ACROPORA TRITA, new species.

Plate 6, figs. 5, 6.

*Description.*—The zoarium is free, cylindrical, bifurcated. The zooecia are indistinct; their frontal is confused with the zoarial surface and it is formed of a tremocyst with small scattered pores. It has no salient peristomes. The peristomice is oblique, elliptical, transverse.

*Measurements.*—Peristomice $\begin{cases} hpe=0.10 \text{ mm.} \\ lpe=0.15 \text{ mm.} \end{cases}$

*Affinities.*—The aspect of this species is that of a *worn* zoarium, thus recalling *Heteropora.* The examination of the transverse section indicates clearly a Cheilostome despite this deceptive appearance. The ascopore is not regularly placed and it is often little discernible as in *Acropora mamillata* D'Archiac, 1846; it differs from the latter species in the absence of a salient peristome.

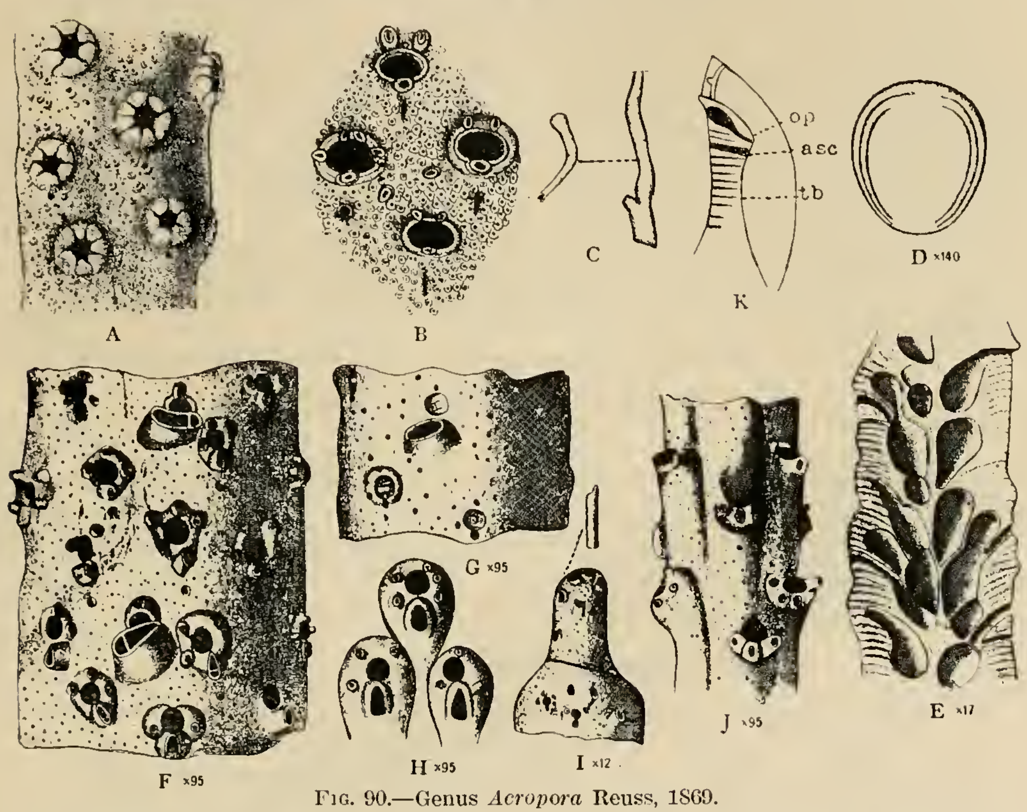

FIG. 90.—Genus *Acropora* Reuss, 1869.

A–E. *Acropora gracilis* Milne-Edwards, 1836. A. Zooecia. (After Milne-Edwards, 1836.) B. Zooecia and avicularia. (After Hincks, 1881.) C. Zoaria, natural size. D. Operculum, × 140. E. Longitudinal section. (C–E after Levinsen, 1909.)

F–K. *Acropora coronata* Reuss, 1869. F, G, H. Three views of zooecia, showing variations of the avicularia, × 95. I. Termination of a branch, natural size, and × 12 showing openings for articular tubes. J. Small form (cf, *Acropora labrosa* Reuss). K. Diagrammatic section through a zooecium; *asc*, ascopore; *op*, operculum; *tb*, tubules. (F–K after Waters, 1891.)

*Occurrence.*—Midwayan (Clayton limestone): One mile west of Fort Gaines, Georgia (rare).

*Cotypes.*—Cat. No. 63817, U.S.N.M.

### ACROPORA SAILLANS, new species.

Plate 85, figs. 4–12.

*Description.*—The zoarium is free, cylindrical, bifurcated, formed of 5 or 6 longitudinal rows of zooecia. The zooecia are distinct, large, elliptical; the frontal is convex and formed of a tremocyst with small scattered pores; it is prolonged into a long peristomie, smooth or a little granular; the ascopore is large and *salient.* The peristome is salient and it supports 2 to 5 small avicularia with pivot; the peristomice is elliptical, transverse, oblique.

*Measurements.*—Peristomice $\begin{cases} hpe=0.10 \text{ mm.} \\ lpe=0.20 \text{ mm.} \end{cases}$ Zooecia $\begin{cases} Lz=0.75\text{–}0.80 \text{ mm.} \\ lz=0.40\text{–}0.50 \text{ mm.} \end{cases}$

*Variations.*—The diagrammatic section (fig. 6) illustrates the structure of this species; the small peristomial avicularia are visible as small cavities.

The ascopore is perfectly visible in the interior (fig. 10). It opens manifestly into the zooecium below the operculum. The frontal is formed of a tremocyst with tubules placed on a very thin perforated olocyst; these tubules have thick walls; it is difficult to see them on the transverse sections (fig. 9).

The longitudinal thin section is very curious (fig. 12). It shows on the median axis a series of fusiform zooecia disposed in chaplet, the latter resulting from the alternation of zooecia as seen in perspective.

*Affinities.*—This species is much larger than *Acropora coronata* Reuss, 1847; the zooecia are more distinct; the peristomial avicularia are smaller.

It differs from *Gastropella asperula* in its frontal with numerous tremopores and in the absence of areolae.

*Occurrence.*—Vicksburgian ("Chimney rock" of Marianna limestone): One mile north of Monroeville, Alabama (very common).

Vicksburgian (Red Bluff clay): Seven and one-half miles southeast of Bladon Springs, Alabama (very rare).

*Cotypes.*—Cat. No. 64263, U.S.N.M.

## Genus GASTROPELLA Canu and Bassler, 1917.

1917. *Gastropella* CANU and BASSLER, Synopsis of American Early Tertiary Cheilostome Bryozoa, Bulletin 96, United States National Museum, p. 37.

An *Acropora* having a smooth frontal garnished laterally with areolae.

*Genotype.*—*Gastropella ventricosa* Canu and Bassler, 1917.

*Range.*—Midwayan-Jacksonian.

### GASTROPELLA VENTRICOSA Canu and Bassler, 1917.

Plate 6, figs. 7–12.

1917. *Gastropella ventricosa* CANU and BASSLER, Synopsis American Early Tertiary Cheilostome Bryozoa, Bulletin 96, United States National Museum, p. 38, pl. 4, fig. 3.

*Description.*—The zoarium is free, cylindrical, bifurcated. The zooecia are large, elliptical, *swollen;* the frontal is smooth, convex, garnished laterally with some large areolae. The ascopore is very large, not salient, placed in the upper third of the zooecia. The peristome is salient and sharp; the peristomice is oblique, orbicular or elliptical. The ovicell is entirely hidden within the thickness of the frontal of the distal zooecium.

*Measurements.*—Peristomice $\left\{\begin{array}{l} hpe=0.10\text{–}0.15 \text{ mm.} \\ lpe=0.15 \text{ mm.} \end{array}\right.$ Zooecia $\left\{\begin{array}{l} Lz=0.85 \text{ mm.} \\ lz=0.40 \text{ mm.} \end{array}\right.$

*Affinities.*—There is frequently a very small peristomial avicularium (fig. 10). On longitudinal sections the ascopore manifestly opens below the apertura (fig. 12); it often appears like a large funnel (fig. 12). On the ovicelled zooecia there is a sort of clamp (*pl*) which is perhaps intended to fasten the operculum during the expulsion of the larva (fig. 11); but it is difficult to comprehend the exact position of this operculum and perhaps we have located it badly if the ovicell is peristomial.

This species differs from *Gastropella asperula* in the more elevated position of the ascopore, in the absence of the numerous avicularia on the peristome, and in the very large areolae.

*Occurrence.*—Midwayan: Mabelvale, near Little Rock, Arkansas (common): one mile west of Fort Gaines, Georgia (common); Luverne, Crenshaw County, Alabama (rare).

*Cotypes.*—Cat. No. 62589, U.S.N.M.

### GASTROPELLA ASPERULA, new species.

Plate 43, figs. 15–18.

*Description.*—The zoarium is free and cylindrical. The zooecia are large, elongated, little distinct; the frontal is smooth, convex, surrounded by small areolae. The ascopore is large, not salient, placed at the middle of the frontal. The peristome is very salient and bears 2 to 6 small avicularia; the peristomice is elliptical, transverse, oblique toward the bottom of the zoarium; the apertura is semielliptical with a concave proximal border.

*Measurements.*—Peristomice $\left\{\begin{array}{l} hpe=0.12\text{–}0.14 \text{ mm.} \\ lpe=0.20 \text{ mm.} \end{array}\right.$ Zooecia $\left\{\begin{array}{l} Lz=0.70\text{–}0.72 \text{ mm.} \\ lz=0.35\text{–}0.40 \text{ mm.} \end{array}\right.$

*Affinities.*—This beautiful species is rather constant in its characters. We have never been able to find an ovicell in our sections.

It differs from *Gastropella ventricosa* in its smaller areolae, its smaller ascopore, and in the presence of many small avicularia on the peristome.

It differs from *Phoceana simulator* with which it occurs and much resembles exteriorly in the presence of an ascopore.

*Occurrence.*—Middle Jacksonian (Castle Hayne limestone): Wilmington, North Carolina (rare).

*Cotypes.*—Cat. No. 64037, U.S.N.M.

### Genus PACHYTHECA Canu, 1913.

1913. *Pachytheca* CANU, Contribution a l'etude des Bryozoaires fossiles, 12, Bryozoaires jurassiques, Bulletin Société Geologique France, ser. 4, vol. 13, p. 142.

The frontal is a thick olocyst. The zoarium is free, and subcylindrical. The ascopore is large and opens exteriorly quite a distance from the peristome.

*Genotype.*—*Pachytheca* (*Porina*) *filiformis* D'Orbigny, 1852.
*Range.*—Campanian-Midwayan.

### PACHYTHECA STIPATA, new species.

Plate 6, figs. 13–15.

*Description.*—The zoarium is free, cylindrical or escharian, bifurcated. The zooecia are little distinct, elongated; the frontal is somewhat convex, smooth. The ascopore is large, deeply imbedded, placed at the middle of the zooecia on the median line. The peristome is salient, wide, supporting four small avicularia; the peristomice is orbicular.

*Measurements.*—Zooecia $\left\{\begin{array}{l} Lz=0.45\text{–}0.50\text{ mm.}\\ lz=0.30\ (?)\text{ mm.}\end{array}\right.$ Peristomice $\left\{\begin{array}{l} hpe=0.10\text{ mm.}\\ lpe=0.10\text{ mm.}\end{array}\right.$

*Affinities.*—The peristomes are *crowded* quite close to one another as in *Beisselina.* The species differs from *Pachytheca* (*Eschara*) *defrancei* Hagenow, 1851, in the presence of avicularia on the peristome.

It differs from *Pachytheca* (*Porina*) *filiformis* D'Orbigny, 1852, in its rarely cylindrical zoarium and in the presence of many (and not of one alone) peristomial avicularia.

*Occurrence.*—Midwayan (Clayton limestone): Luverne, Crenshaw County, Alabama (common).

*Cotypes.*—Cat. No. 63819, U.S.N.M.

### Genus BEISSELINA Canu, 1913.

1913. *Beisselina* Canu, Contributions a l'etude des Bryozoaires fossiles, 13, Bryozoaires jurassiques, Bulletin Société Geologique, France, ser. 4, vol. 13, p. 138.

The tubules are large and often are replaced by some small avicularia; they hide the true zooecial form. The zoarium is free and escharian.

*Genotype.*—*Beisselina* (*Eschara*) *striata* Goldfuss, 1826.

*Range.*—Cenomanian-Jacksonian.

It is impossible to confuse the genera *Aeropora* Reuss, 1869, and *Beisselina* Canu, 1913. However, it is difficult to find any physiologic character clearly different. It is true that we are always ignorant of the function of the avicularia and of the tubular tremopores.

### BEISSELINA FORATA, new species.

Plate 6, figs. 16–20.

*Description.*—The zoarium is free, escharian; the two lamellae, back to back are inseparable. The zooecia are indistinct. The peristome is thin, sharp, very little salient; the peristomice is orbicular. The frontal *pores* are large, orbicular, numbering 5 or 6. The ascopore is large and in aspect little different from the other pores.

*Measurements.*—Peristomice $\left\{\begin{array}{l} hpe=0.09\text{ mm.}\\ lpe=0.09\text{ mm.}\end{array}\right.$

*Affinities.*—The elements of the olocyst (fig. 20) are regularly disposed in quincunx.

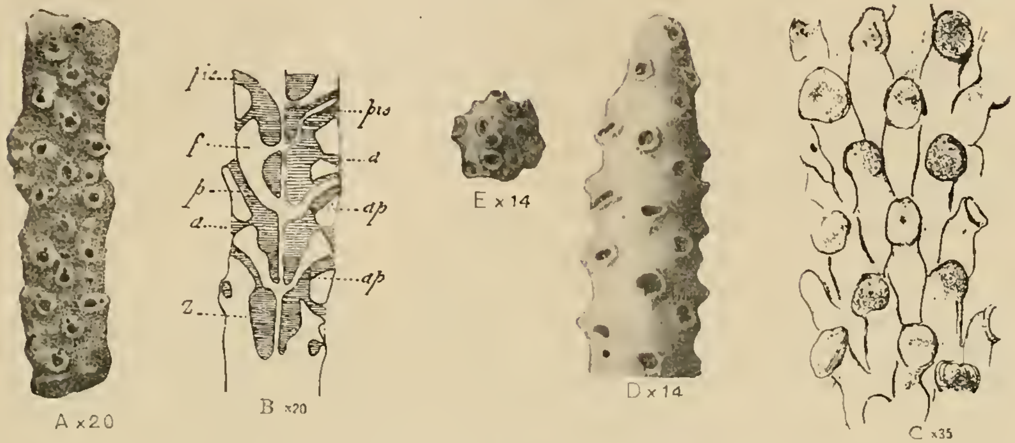

FIG. 91.—Genus *Pachytheca* Canu, 1913.

A, B. *Pachytheca filiformis* D'Orbigny, 1852. A. Zoarium, × 20. B. Longitudinal section. × 20. (A, B after Canu, 1913.) *a*, ascopore; *ap*, apertura; *f*, frontal thickening; *p*, peristomie; *pis*, peristomice; *z*, zooecium.

C, D. *Pachytheca bosqueti* Beissel, 1863. C. Cast of the interior, × 35. D. Extremity of a branch, profile view, × 14. E. The same extremity seen from the top, × 14. (C–F after Beissel, 1863.)

This species differs from *Beisselina midwayanica* in its very large frontal pores, in the somewhat larger diameter of the peristomice (0.09 mm. instead of 0.06 mm.). and in its somewhat prominent peristome.

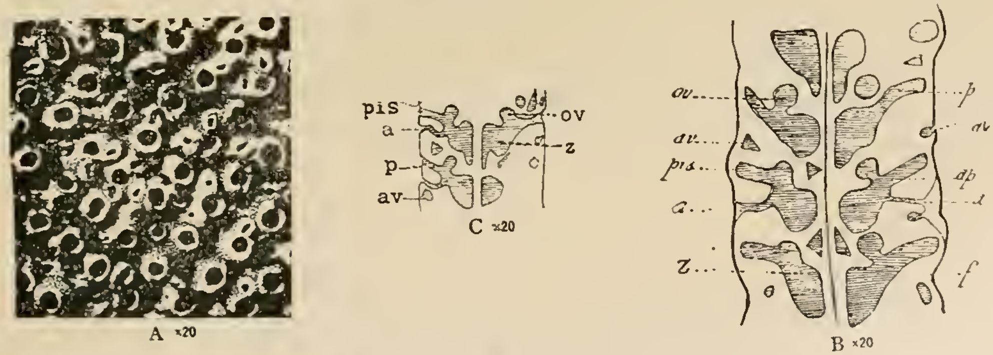

FIG. 92.—Genus *Beisselina* Canu, 1913.

A, B. *Beisselina boryana* von Hagenow, 1851. A. Surface of zoarium, × 20. B. Longitudinal section, × 20. (A, B after Canu, 1913.) *a*, ascopore; *ap*, aperture; *av*, avicularian cavity; *f*, frontal thickening; *ov*, ovicell; *p*, peristomie; *pis*, peristomice; *z*, zooecium.

C *Beisselina striata* Goldfuss, 1827. Longitudinal section, × 20. Lettering same as on fig. B.

*Occurrence.*—Midwayan (Clayton limestone): Mabelvale, near Little Rock. Arkansas (rare).

*Cotypes.*—Cat. No. 63820, U.S.N.M.

### BEISSELINA MIDWAYANICA, new species.

Plate 7, figs. 1–13.

*Description.*—The zoarium is a bifurcated Eschara; the fronds are compressed, little thick; the two lamellae, back to back, are inseparable. The zooecia are indistinct; the frontal is perforated with some pores irregularly placed. There is no peristome; the peristomice is small and orbicular. The ascopore is large and placed on the median axis of the zooecia.

*Measurements.*—Peristomice $\left\{\begin{array}{l} hpe=0.06 \text{ mm.} \\ lpe=0.06 \text{ mm.} \end{array}\right.$

*Variations.*—The frontal pores are absent (fig. 3), rare (fig. 4), or abundant (fig. 2). In the interior (fig. 5) the pores appear like perforations direct in the olocyst. The transverse sections (fig. 7) indicate some lateral walls, quite thin and intimately joined. On the transverse thin section the two lamellae are distinct and the olocystal elements are grouped in a transversal line. These elements are very dense, quite crowded, and it is difficult to obtain sections sufficiently transparent (fig. 11). The longitudinal section (fig. 12) is difficult to interpret; but our schematic figure is perfectly exact.

*Affinities.*—This species differs from *Beisselina forata* in its smaller orifice (0.06 instead of 0.09 mm.), in its rarer and smaller frontal pores, and in the absence of the peristome.

Sometimes there are some large salient avicularia with pivot as in *Beisselina labiata* Gabb and Horn, 1862, of the Vincentown marl (see plate 7, fig. 14). It differs from this Cretaceous species in the absence or the rarity of the large frontal avicularium, in the smaller diameter of its peristomice (0.06 mm. and not 0.11 mm.), in its smaller ascopore, and in the absence of the peristome.

*Occurrence.*—Midwayan (Clayton limestone): One mile west of Fort Gaines, Georgia (very common); Mabelvale, near Little Rock, Arkansas (common); Luverne, Crenshaw County, Alabama (rare).

*Cotypes.*—Cat. No. 63821, U.S.N.M.

### BEISSELINA TRULLA, new species.

Plate 43, figs. 19–21.

*Description.*—The zoarium is an Eschara with wide and rounded fronds; the two lamellae are inseparable. The zooecia are elongated, distinct; the frontal is ornamented with 6 or 7 large pores of which one is an ascopore. The peristome is salient, thin, and sharp; the peristomice is orbicular.

*Measurements.*—Peristomice $\left\{\begin{array}{l} hpe=0.11 \text{ mm.} \\ lpe=0.11 \text{ mm.} \end{array}\right.$ Zooecia $\left\{\begin{array}{l} Lz=0.55 \text{ mm.} \\ lz=0.24 \text{ mm.} \end{array}\right.$

*Affinities.*—This species is easy to recognize by its distinct zooecia and its frontal perforated like a *colander*. It differs from *Beisselina implicata* in the size of its frontal pores which attain 0.04 mm. in diameter and in its much larger peristomice (0.11 and not 0.06 mm.).

It differs from *Beisselina forata*, which is also provided with large frontal pores, in its larger zooecial and zoarial dimensions.

*Occurrence.*—Lower Jacksonian (Moodys marl): Jackson, Mississippi (rare).

*Holotype.*—Cat. No. 64038, U.S.N.M.

### BEISSELINA IMPLICATA, new species.

Plate 44, figs. 1–4.

*Description.*—The zoarium is an Eschara with fronds linear and elongated. The zooecia are hardly distinct; the frontal bears 2 to 4 pores, an ascopore, and a small, salient avicularium; the peristome is salient; the peristomice is orbicular.

*Measurements.*—Peristomice $\begin{cases} hpe=0.06\text{–}0.07 \text{ mm.} \\ lpe=0.06\text{–}0.07 \text{ mm.} \end{cases}$

*Affinities.*—This species, complicated in appearance, differs from *Beisselina trulla* in its little distinct zooecia, in its smaller frontal pores, and in the smaller diameter of its peristomice (0.07 mm. instead of 0.11 mm.).

Figure 3 perhaps represents a distinct species, but it is the only specimen found.

In the geologic column this is the last *Beisselina* observed. We have no knowledge of the genus in the Miocene or Pliocene.

The small salient avicularium is far from being constant and many specimens are deprived of it.

*Occurrence.*—Upper Jacksonian (Ocala limestone): Alachua, Florida (common); 9 miles north of Ocala, Florida (rare); 1½ miles above Bainbridge, Georgia (rare).

*Cotypes.*—Cat. Nos. 64039, 64040, U.S.N.M.

## Family HIPPOTHOIDAE Levinsen, 1909.

The zooecia become calcified from behind in successive zones forward, leaving at the surface more or less salient lines, the lines of growth, and are furnished with a variable number of dietellae.

The genera of this family are as follows:

*Hippothoa* Lamouroux, 1821.
*Chorizopora* Hincks, 1880.
*Trypostega* Levinsen, 1909.
*Haplopoma* Levinsen, 1909.
*Dacryopora* Lang, 1914.

This family, in spite of its exterior appearances, is not a natural one. The larva of *Chorizopora* is not identical with that of *Hippothoa* and *Haplopoma*. The ovicell of *Trypostega* is not like the gonoecia of other genera. We have therefore not given a general table for the family, but have indicated the zoological bibliography for each genus.

### Genus HIPPOTHOA (Lamouroux, 1821) Hincks, 1880.

*Zoological bibliography.*—1877. Barrois, Recherches sur l'embryologie des Bryozoaires, Travaux de l'Institut de zoologie, fasc. 1, p. 149, pl. 9, figs. 4, 16.—1886. Jullien, Mission scientifique du Cap Horn, vol. 6, Zoology, p. 28, pl. 4, figs. 1–4.—1900. Waters, Bryozoa from Franz Joseph Land, Journal Linnean Society, London, vol. 28, p. 70, pl. 8, figs. 16–18.—1900. Levinsen, Morphological and systematic studies on the Cheilostomatous Bryozoa, p. 276, pl. 18, fig. 9.—1904. Waters, Expédition Antarctique belge, Bryozoa, p. 53, pl 3, fig. 8.

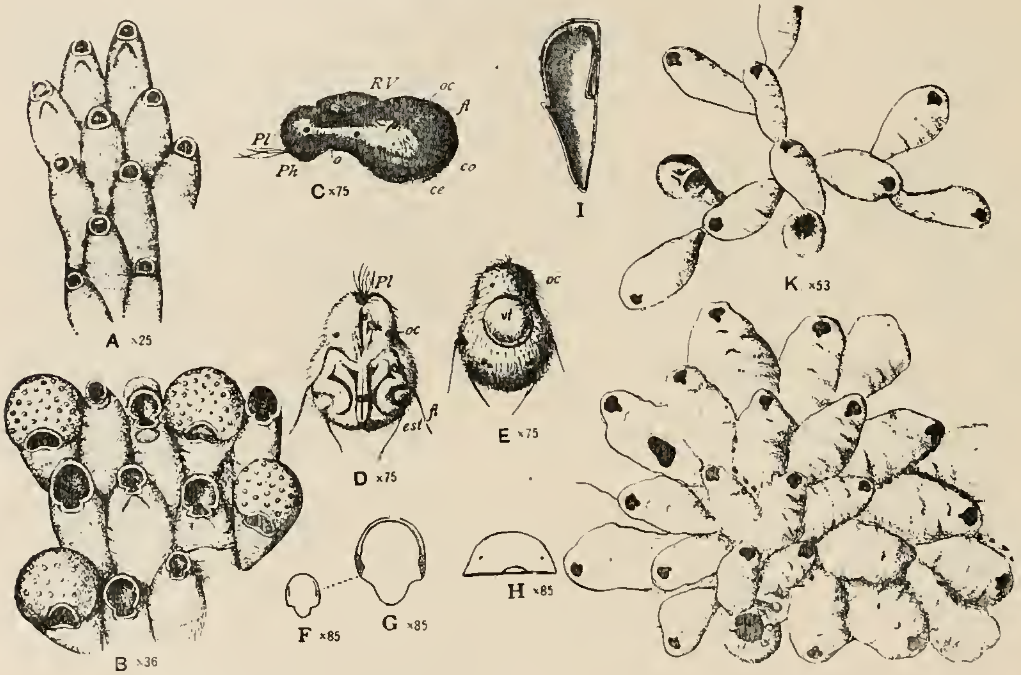

Fig. 93.—Genus *Hippothoa* Lamouroux, 1821 (Hincks, 1880).

A–I. *Hippothoa hyalina* Linnaeus, 1758. A. Portion of zoarium, × 25. B. Zoarium with ovicelled zooecia, × 36. (After Hincks, 1880.) C. Free larva, profile view, × 75. D. Oral face of larva, showing the singular structure of the stomach, × 75. E. Aboral face of larva, × 75. showing the simplicity of the structure of the terminal bud. (G–E after Barrois, 1909.) *cd*, digestive cavity; *cc*, obscure portion of the body cavity included between the two branches of the stomach (=orifice of the external sack); *est*, stomach; *fl*, flagellum; *o*, mouth of the gastrula (=ciliated cleft); *oc*, oculiform points (=pigment spots); *ph*, pharpnx; *pl*, vibratile plume; *rv*, border of the terminal bud (=calotte). F. Operculum of male zooecium, × 85. G. Operculum of ordinary zooecium, × 85. H. Operculum of ovicelligerous zooecium, × 85. (F–H after Waters, 1900.) I. A sagittal section through a gonozooecium. The ovicell is surrounded by a kenozooecium. (After Levinsen, 1909.) J, K. *Hippothoa bougainvillei*, D'Orbigny, 1839. J. Young, uniserial zoarium with a spinous ancestrula and with a gonoecium without polypide, × 53. (J, K after Jullien, 1888.) K. Young zoarium exhibiting spinous ancestrula with opesium, × 53.

The frontal of the zooecia is not porous. The operculum is compound. The aperture is provided with two much developed hinge-teeth and with a more or less angular rimule. The gonoecia are larger than the other zooecia and have a different form; they never contain a polypide; they contain an ovary and an incubation cavity which is a sort of endozooecial ovicell. There are male zooecia smaller than the normal zooecia.

*Genotype.*—*Hippothoa divaricata* Lamouroux, 1821.

*Range.*—Lutetian-Recent.

*Historical.*—Lamouroux created this genus for all uniserial incrusting zoaria of Ascophora bearing generally zooecia very much narrowed behind. The genus was based entirely on zoarial features. By juggling the definition, it was transformed in 1880 by Hincks into a genus based on zoöecial features, and included only those species in which the aperture bears a small rimule. It is evident that we may observe hippothoiform zooecia provided with a different hydrostatic system and consequently with an aperture of a different form.[1] Furthermore, Jullien in 1886 dismembered the old genus *Hippothoa* and applied the name of *Diazeuxia* to the group of the species with a small rimule. Waters, in 1900, and Levinsen, in 1909, preserved the definition of Hincks.

### HIPPOTHOA (?) CONJUNCTA, new species.

Plate 7, figs. 15, 16.

This species is certainly not a *Hippothoa*, for its aperture is elliptical and without a small rimule. The four specimens discovered are too few for the study of characters sufficient to establish a new genus, especially as they bear no ovicell.

The zooecia are provided with a caudal portion, which is very long, thin, and stoloniform. When such a portion encounters another they join together and the gemmation of a branch is arrested. This is a peculiarity which we have never observed in *Hippothoa*.

*Occurrence.*—Midwayan (Clayton limestone): Lüverne, Crenshaw County, Alabama (rare).

*Cotypes.*—Cat. No. 63823, U.S.N.M.

### HIPPOTHOA ? species undetermined.

Plate 44, fig. 5.

The specimen collected is very mediocre and bears only a single zooecium intact. In the form of its aperture it is neither *Hippothoa* nor *Dacryopora*. We have mentioned it simply to call attention to the occurrence.

*Occurrence.*—Upper Jacksonian (Ocala limestone): Chipola River, east of Marianna, Jackson County, Florida (rare).

## Genus TRYPOSTEGA Levinsen, 1909.

*Zoological bibliography.*—1909. Levinsen, Morphological and systematic studies on the Cheilostomatous Bryozoa, p. 280, pl. 19, fig. 1; pl. 23, fig. 13.—1913. Waters, The Marine Fauna of British East Africa and Zanzibar, Proceedings Zoological Society, London, p. 507.

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[1] This is notably so in the case of the genus *Dacryopora* Lang, 1914 (Geological Magazine, ser. 6, vol. 1, p. 440, pl. 34, figs. 4 and 5).

The zooecia have a compound operculum; they are surmounted by a small, elongated, constant zooeciule which is closed by a chitinous operculum. The female zooecia bear a hyperstomial ovicell which is always closed by the operculum.

*Genotype.*—*Trypostega* (*Schizoporella*) *venusta* Norman, 1864.

*Range.*—Jacksonian-Recent.

The organization of the female zooecia is very different from that of the gonoecia of *Hippothoa*. There is certainly a polypide; the larvae develop in an ovicell embedded in the distal zooecia, but the ovicell is closed by the operculum. It is probable that the larvae are different from those of the other genera. The zooeciules (=suprazooecial chambers of Waters and dwarf zooecia of Levinsen) are the organisms whose functions are unknown: they are unprovided with polypide.

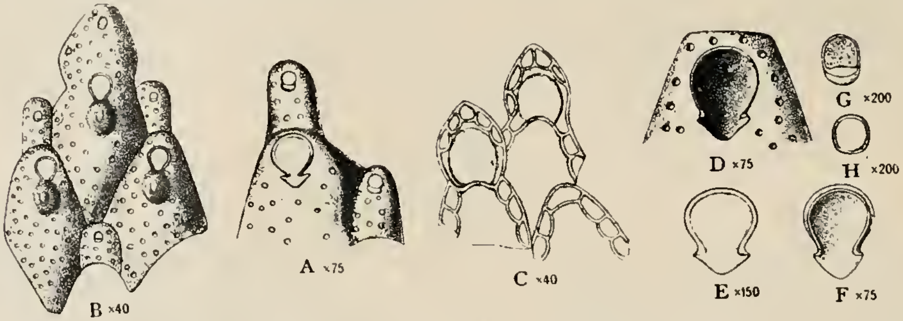


FIG. 94.—Genus *Trypostega* Levinsen, 1909.

A–H. *Trypostega venusta* Norman, 1864. A. A zooecium and two zooeciules, × 75. B. Drawing showing three zooeciules and a larger one surrounding an ovicell, × 40. C. View from the basal surface, × 40. Two ovicells are seen surrounded by zooeciules, which, like the ordinary zooecia, are furnished with dietellae, × 40. D. Apertura, × 75. E, F. Opercula, × 150 and 75. G. Apertura of zooeciule with operculum, × 200. H. Operculum of a zooeciule, × 200. (A–H. After Levinsen, 1909.)

### TRYPOSTEGA ELONGATA, new species.

Plate 9, fig. 17.

*Description.*—The zoarium incrusts shells. The zooecia are distinct, elongated, fusiform; the frontal is convex and perforated with numerous pores scattered and disposed in quincunx. The apertura is formed of a large semicircular anter separated by two cardelles from a small, somewhat convex poster. The ovicell is large, salient, porous, elongated, carinated; it is hyperstomial and always closed by the operculum. The zooeciules are elongated, fusiform; their small orifice is elliptical.

*Measurements.*—Apertura $\begin{cases} ha=0.06 \text{ mm.} \\ la=0.08 \text{ mm.} \end{cases}$ Zooecia $\begin{cases} Lz=0.40 \text{ mm.} \\ lz=0.28 \text{ mm.} \end{cases}$

*Affinities.*—This species differs from *Trpostega venusta* Norman, 1864, of the Vicksburgian, in the greater length of its zooeciules ($Lz=0.20$ mm. instead of 0.10 mm.), and in its slightly smaller apertura.

In spite of the imperfections of the few specimens discovered it was interesting to note this species, for it completes the geologic series in the distribution of the genus. We are acquainted with *Trypostega* species from the Lutetian of southern France and *Trypostega aquitanica* Canu, 1906, from the Stampian of southern France.

*Occurrence.*—Wilcoxian (Bashi formation): Woods Bluff, Alabama (rare).

*Holotype.*—Cat. No. 63836, U.S.N.M.

### TRYPOSTEGA UNDULATA, sew species.

Plate 44, figs. 6, 7.

*Description.*—The zoarium incrusts shells and bryozoa. The zooecia are small, distinct, elongated, pyriform; the frontal is convex, ornamented with transverse undulations and often with an infra-oral gibbosity, and unprovided with visible pores. The ovicell is elongated, prominent, smooth, globular, hyperstomial, and always closed by the operculum. The aperture is semilunar; the proximal border is straight and bears a large rectangular rimule. The zooeciules are small, elliptical, perforated by a very small circular orifice.

*Measurements.*—Aperture $\begin{cases} ha=0.07 \text{ mm.} \\ la=0.05 \text{ mm.} \end{cases}$ Zooecia $\begin{cases} Lz=0.36\text{–}0.40 \text{ mm.} \\ lz=0.24 \text{ mm.} \end{cases}$

*Affinities.*—This species differs from *Trypostega inornata* Gabb and Horn, 1862, in its distinctly smaller dimensions ($Lz$=0.40 mm.), its frontal undulations and its infra-oral gibbosity.

It differs from *Trypostega venusta* Norman, 1864, in its smooth, nonporous frontal and its smaller oral dimensions.

It differs from *Trypostega aquitanica* Canu, 1906, of the French Stampian, in the absence of a distally much developed peristome.

*Occurrence.*—Middle Jacksonian: Rich Hill 5¼ miles southeast of Knoxville, Georgia (rare); 18 miles west of Wrightsville, Georgia (rare); Baldock, Barnwell County, South Carolina (rare).

Upper Jacksonian (Ocala limestone): Near Georgia Kaolin Company's mine, Twiggs County, Georgia (very rare); Old Factory, 1½ miles above Bainbridge, Georgia (very rare).

*Cotypes.*—Cat. No. 64042, U.S.N.M.

### TRYPOSTEGA INORNATA Gabb and Horn, 1862.

Plate 44, figs. 8–10.

1862. *Cellepora inornata* Gabb and Horn, Monograph Polyzoa Secondary and Tertiary North America, Journal Academy Natural Science, Philadelphia, ser. 2, vol. 5, p. 127, pl. 19, fig. 10.

*Description.*—The zoarium incrusts shells. The zooecia are elongated, distinct, pyriform; the frontal is smooth and nearly flat. The aperture is formed of an anterior semilunar portion and of a wide rounded rimule. The ovicell is large, somewhat globular, smooth. The zooeciules are small, elliptical, smooth, perforated by a very small orifice.

*Measurements.*—Aperture $\begin{cases} ha=0.08\text{–}0.10\text{ mm.} \\ la=0.06\text{–}0.08\text{ mm.} \end{cases}$ Zooecia $\begin{cases} Lz=0.44\text{–}0.50\text{ mm.} \\ lz=0.26\text{–}0.30\text{ mm.} \end{cases}$

*Affinities.*—Smitt, in 1873, identified this species with *Trypostega venusta* Norman, 1864. We can not subscribe to this identification, for the American authors do not mention the frontal pores at all. Another part of their description corresponds much better to the present species than to *Trypostega undulata* in which the zooecia are very convex. They write as follows: "Cellules slightly convex, oval . . ." and "The oval plain, small cellules, with the mouth ovoid to subtriangular. . . ." They confound the zooeciules (figured) with the ovicells, yet they say in the text, that "the ovarian vesicle is something much broader than shown in the figure, sometimes attaining as great a width as the cellule itself."

This species differs from *Trypostega undulata* in its less convex frontal, its larger micrometric dimensions ($Lz$, 0.44–0.50 mm. instead of 0.40 mm.), in the larger aperture, and in the absence of undulations and frontal gibbosities.

It differs from *Trypostega venusta* Norman, 1864, in its larger micrometric dimensions and its smooth frontal, which is not perforated by scattered pores.

*Occurrence.*—Upper Jacksonian (Ocala limestone): Chipola River, east of Marianna, Florida (rare); west bank of the Sepulga River, Escambia County, Alabama (rare).

Vicksburgian (Marianna limestone): Salt Mountain, 5 miles south of Jackson, Alabama (rare); Murder Creek, east of Castlebury, Alabama (rare); near Claiborne, Monroe County, Alabama (rare); west bank of Conecuh River, Escambia County, Alabama (rare); one mile north of Monroeville, Alabama (common); three miles southeast of Vosburg, Jasper County, Mississippi (rare); deep well, Escambia County, Alabama (very rare).

*Plesiotypes.*—Cat. Nos. 64043–64045, U.S.N.M.

### TRYPOSTEGA VENUSTA Norman, 1864.

Plate 85, figs. 15, 16.

1851. *Mollia tuberculata* D'ORBIGNY, Paleontologie Française, Description des animaux invertébrés, Terrain crétacé, vol. 5, Bryozoaires, p. 388, not figured; see Waters, Annals Magazine Natural History, ser. 7, vol. 15, p. 6.

1864. *Lepralia venusta* NORMAN, On undescribed British Polyzoa, Annals Magazine Natural History, ser. 3, vol. 13, p. 84, pl. 10, figs. 2, 3.

1873. *Gemellipora glabra*, form *striatula* SMITT, Floridan Bryozoa, pt. 2, Kongl. Svenska Vetenskaps-Akademiens Handlingar, vol. 11, No. 4, p. 37, pl. 11, p. 207.

1880. *Schizoporella venusta* HINCKS, British Marine Polyzoa, p. 276, pl. 30, figs. 6, 7.

1882. *Lepralia striatula* MACGILLIVRAY, Descriptions of new or little known Polyzoa, Transactions of the Royal Society of Victoria, pt. 2, vol. 19, p. 134, pl. 3, fig. 17.

1885. *Schizoporella striatula* WATERS, Cheilostomatous Bryozoa from Aldinga and the River Murray Cliffs, South Australia, Quarterly Journal of the Geological Society of London, vol. 41, p. 301.

1887. *Gemellipora striatula* MacGillivray, Bryozoa in McCoy's Prodromus of the Zoology of Victoria, vol. 2, dec. 14, p. 150, pl. 138, fig. 10.

1888. *Schizoporella venusta* Kirkpatrick, Polyzoa of Mauritius, Annals Magazine Natural History, ser. 6, vol. 1, p. 76.

1890. *Schizoporella venusta* Kirkpatrick, Hydroida and Polyzoa from the China Sea, Annals Magazine Natural History, ser. 6, vol. 5, p. 17.

1890. *Schizoporella venusta* Kirkpatrick, Proceedings Royal Society Dublin, n. s. vol. 6, p. 612.

1899. *Schizoporella striatula* Phillips, Report on the Polyzoa from Loyalty Isles, New Guinea and New Britain, Zoological Results, A. Willey, pt. 4, p. 440.

1902. *Trypostega venusta* Levinsen, Studies on Bryozoa, Vidensk Medd. fra den Naturh. Foren. i Kjøbenhaven, p. 23.

1907. *Schizoporella venusta* Calvet, Expedition Scientific du *Travailleur* et *Talisman*, vol. 8, p. 416.

1909. *Trypostega venusta* Levinsen, Morphological and Systematic Studies on Cheilostomatous Bryozoa, p. 281, pl. 19, figs. 1*a*–1*d*; pl. 22, figs. 13*a*–13*d*.

1909. *Trypostega venusta* Norman, Polyzoa from Madeira, Journal Linnean Society Zoology, vol. 30, p. 299.

1912. *Gemellipora glabra*, form *striatula* Thornely, Marine Polyzoa Indian Ocean, Transactions Linnean Society Zoology, vol. 15, p. 149.

1913. *Trypostega venusta* Waters, The Marine Fauna of British East Africa and Zanzibar, Proceedings Zoological Society London, p. 506.

1914. *Trypostega venusta* Osburn, The Bryozoa of the Tortugas Islands, Florida, Publication Carnegie Institution Washington, No. 182, p. 198.

*Measurements.*—Aperture $\begin{cases} ha=0.08\text{–}0.10\text{ mm.} \\ la=0.06\text{–}0.08\text{ mm.} \end{cases}$ Zooecia $\begin{cases} Lz=0.40\text{–}0.46\text{ mm.} \\ lz=0.26\text{–}0.30\text{ mm.} \end{cases}$

*Affinities.*—Doctor Osburn has been kind enough to send us a recent specimen from Beaufort, and we have thus been able to make all the comparisons with great facility. Undoubtedly our specimens belong to the recent species, everywhere very cosmopolitan, although their micrometric dimensions are slightly smaller.

The frontal pores are rather large and scattered. The zooeciules are small and pyriform: their orifice is orbicular and quite variable in size.

This species differs from *Trypostega undulata* in which the dimensions are very close, in its frontal perforated by a larger orifice ($ha=0.08$–$0.10$ mm. instead of 0.06–0.07 mm.), and in the absence of a rectangular rimule at the aperture.

It differs from *Trypostega inornata* Gabb and Horn, 1862, in its perforated frontal and its smaller micrometric dimensions ($Lz$ smaller than 0.45 mm.).

It differs from *Trypostega aquitanica* Canu, 1906, in the absence of a distal thickening at the peristome. This character is unimportant, and it may be that the French species is only a variety of the recent form.

Abrasion of the surface of the zooecia permits of the ready discovery of dietellae (fig. 15); their number is variable; there are none around the zooeciules.

The frontal gibbosity is not constant on the recent species; the specimen received from Doctor Osburn notably, is deprived of it and our fossil specimens resemble the recent one absolutely.

*Occurrence.*—Vicksburgian (Byram marl): Byram, Mississippi (rare); one-fourth mile west of Woodward, Wayne County, Mississippi (rare).

Vicksburgian (Marianna limestone): Near Claiborne, Monroe County, Alabama (rare).

*Geological distribution.*—Miocene, South Australia. (Waters.)

*Habitat.*—Atlantic: In the English Channel, off Madeira, Azores and Cape Verde Islands, Florida. Pacific: China seas (45 m.), Torres Strait, Amirante (36–140 m.), Saya de Malha (48–200 m.), Mauritius, Wasin (16 m.), British East Africa.

*Plesiotypes.*—Cat. No. 64266, U.S.N.M.

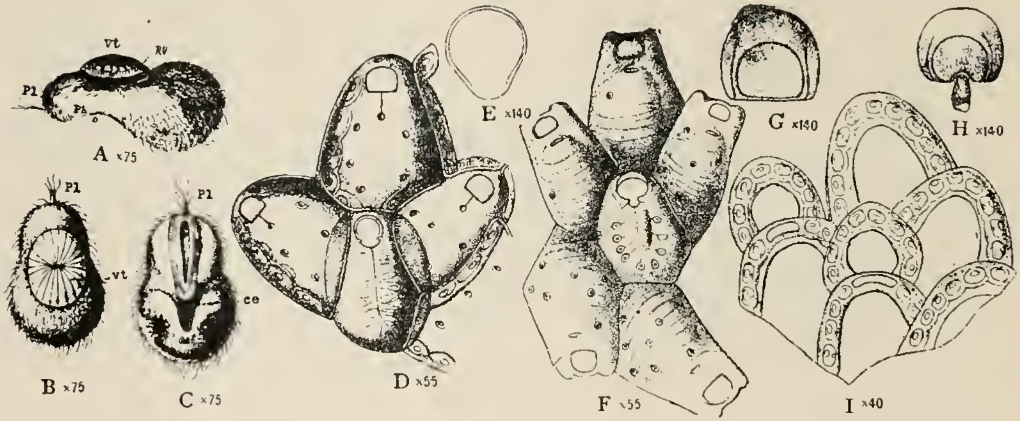


FIG. 95.—Genus *Haplopoma* Levinsen, 1909.

A–I. *Haplopoma impressum* Audouin, 1826. A. Free larva in profile, × 75. B. View of larva, aboral face, × 75, showing the arrangement of the striations of the terminal bud. C. Oral face of larva, × 75, exhibiting the general form of the stomach. (A–C after Barrois, 1877.) *ce*, orifice of the internal sac; *est*, stomach; *o*, mouth of the gastrula; *ph*, pharynx; *pl*, ciliary plume; *RV*, border of the terminal bud; *vt*, terminal bud. D. Group with primary zooecium (=ancestrula), × 55. In the margin of the zooecia internal dietellae are visible. E. The operculum of the ancestrula of fig. D, × 140. F. Zooecia with ancestrula, × 55. G. Operculum, × 140. H. Operculum of the ancestrula of fig. F, × 140. I. View from the basal surface. The zooecia and the kenozooecia surrounding the ovicells are furnished with dietellae, × 40. (D–I after Levinsen, 1909.)

### Genus HAPLOPOMA Levinsen, 1909.

*Zoological bibliography.*—1877. BARROIS, Recherches sur l'embryologie des Bryozoaires, p. 171, pl. 9, figs. 1–3.—1909. LEVINSEN, Morphological and Systematic Studies on the Cheilostomatous Bryozoa, p. 280, pl. 18, fig. 11; pl. 22, figs. 9, 10.

The frontal of the zooecia is garnished with scattered pores; it is perforated by a median ascopore opening into the compensation sac. The operculum is simple. The ovicell is closed by the operculum. The ancestrula has no ascopore, but the aperture bears a rimule which opens into the compensation sac. Fifteen tentacles.

*Genotype.*—*Haplopoma* (*Flustra*) *impressa* Savigny-Audouin, 1826.

*Range.*—Tortonian-Recent.

### Genus CHORIZOPORA Hincks, 1880.

*Zoological bibliography.*—1880. HINCKS, British Marine Polyzoa, p. 222, pl. 32, figs. 1–4.—1900. CALVET, Contribution à l'histoire naturelle des Bryozoaires ectoproctes marins, p. 348, pl. 11, figs. 13–15.—1909. LEVINSEN, Morphological and Systematic Studies on the Cheilostomatous Bryozoa, p. 276, pl. 18, fig. 10*a*.

The zooecia are more or less distant, connected by a tubular network; the aperture is semicircular with the inferior margin entire. The ovicells are covered by avicularia.

*Genotype.—Chorizopora* (*Flustra*) *brongniarti* Savigny-Audouin, 1826. Recent.

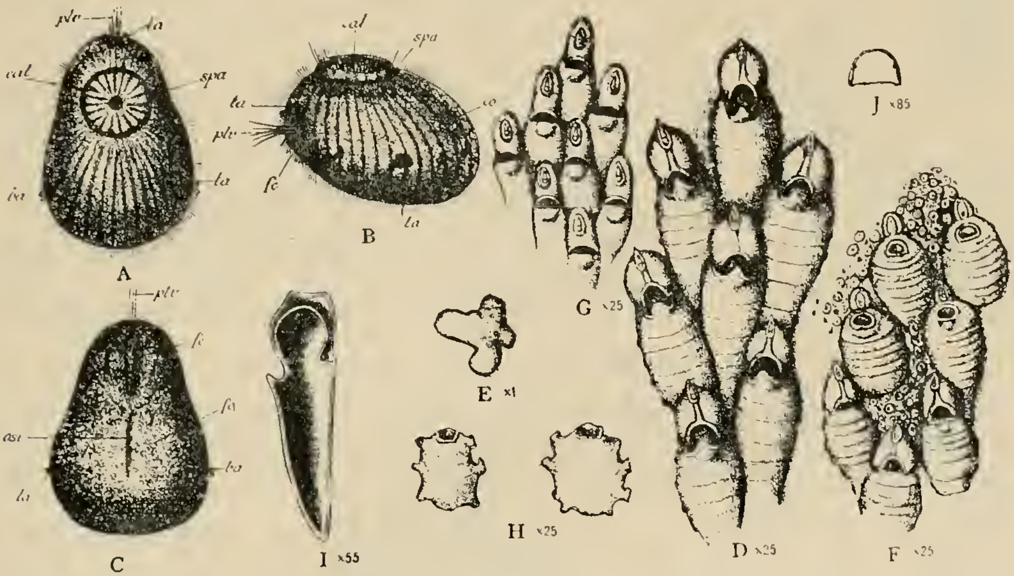


FIG. 96.—Genus *Chorizopora* Hincks, 1880.

A–H. *Chorizopora brongniarti* Audouin, 1826. A. View of dorsal or aboral face of larva. B. Larva seen laterally and from its left face. C. Ventral (oral) face of larva. (A–C after Calvet, 1900.) *ba*, palette of the pigment spots; *cal*, calotte; *co*, corona; *fc*, ciliated cleft; *fo*, oral face; *osi*, orifice of the internal sack; *plv*, vibratile plume; *spa*, palleal furrow; *ta*, pigment spots. D. Zooecia with ovicells, × 25. E. Zoarium, natural size. F. Zooecia, × 25. G. Zooecia, × 25. H. Detached zooecia, × 25, showing the tubular connections around the edge. (D–H after Hincks, 1882.) I. Longitudinal section of an ovicelled zooecium, × 55. The ovicell is surrounded by an avicularium. (After Levinsen, 1909.)

### Genus DACRYOPORA Lang, 1914.

1914. *Dacryopora* LANG, Cretaceous Cheilostome Polyzoa, Geological Magazine, ser. 6, vol. 1, p. 440.

*Description.*—Incrusting, uniserial Cheilostome Polyzoa, normally with bilateral branching; zooecia monomorphic, divided into a proximal caudal and a distal capitular portion; termen, except distally, indicated by a contour on the complete front wall at which the slope of the front wall changes; distally it coincides with the lateral and distal edges of the orifice, and bears one or more pairs of spines; extraterminal front wall comparatively small and slightly arched; intraterminal front wall entirely calcareous, highly arched, often bearing a median ridge; aperture semicircular or slightly cribrilinid. (After Lang.)

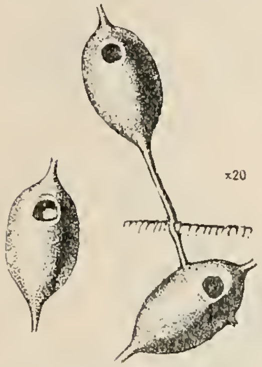


Fig. 97.—Genus *Dacryopora* Lang, 1914.

*Dacryopora gutta* Lang, 1914. (After Lang.) Two zooecia, × 20. Senonian, Chatham, Kent, England.

*Genotype.*—*Dacryopora gutta* Lang, 1914.

*Range.*—Cenomanian-Senonian.

### Genus HARMERIA Norman, 1903.

1903. *Harmeria* Norman, Notes on Natural History of East Finmark, Annals and Magazine Natural History, ser. 7, vol. 12, p. 107.

"The zooecia lack a covering membrane; the calcareous matter is very thin and brittle and there are no spines. They present a larger or smaller distinctly defined frontal area, provided with numerous pores. A compound operculum, feebly chitinized. Rosette plates with few pores. No ovicell and no avicularia. The disciform colony presents two different sizes of zooecia, larger inner and small outer." (Levinsen, 1916.)

*Genotype.*—*Harmeria* (*Lepralia*) *scutulata* Busk. Recent.

## Family ESCHARELLIDAE Levinsen, 1909.

The ovicell is hyperstomial. The operculum is rigid and chitinous; it closes the aperture, the compensatrix and often the ovicell; its form is in rapport with the hydrostatic system and the passage of the eggs into the ovicell.

*Historical.*—This family is the reunion of the old families of Microporellidae, Myriozoidae and Escharidae (part) of Smitt and Hincks. Levinsen, in 1909, having proved the identity of the larvae formed the family of Escharellidae, but the name is badly chosen, for it is based on an archaic genus which the more recent work will not permit us to employ.

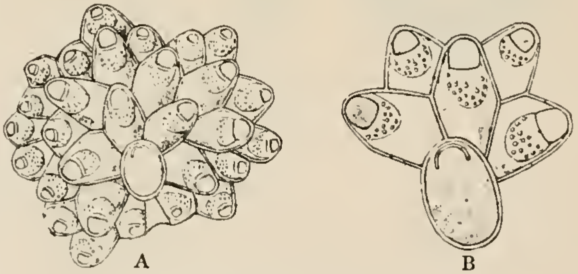


Fig. 98.—Genus *Harmeria* Norman, 1903.

A, B. *Harmeria scutulata* Busk. (After Levinsen, 1916.) A. Colony with an ovate membraniporoid ancestrula surrounded by five large and three smaller zooecia. B. Ancestrula with the five surrounding larger zooecia.

*Division.*—According to the form of the operculum we may class the numerous genera of this family in the following four large groups, although there are some aberrant genera:

Schizoporellae.
Hippoporae.
Microporellae.
Peristomellae.

Evidently the hydrostatic and reproductive functions are identical in each but they operate in a quite variable manner. These variations added to those of calcification, which is also an important function, permits the establishment of a large number of genera almost all rather natural however, which facilitate the study of this very important family. The anatomical structure is given in detail for each group.

### Group 1. SCHIZOPORELLAE Canu and Bassler, 1917.

*Bibliography* (*Anatomical*).—1877. BARROIS, Recherches sur l'embryologie des Bryozoaires, pls. 7, 8, figs. 8, 10, 11, 21; pl. 8, figs. 30, 33, 35.—1888. JULLIEN, Mission scientifique du Cap Horn, p. 48.—1892. WATERS, Observations on the Gland-like Bodies in the Bryozoa, Linnean Society Journal, vol. 24, pl. 19, figs. 6–13.—1900. CALVET, Contribution à l'Histoire naturelle des Bryozoaires ectoproctes marins, pl. 10, figs. 8, 9; pl. 11, figs. 16, 17.—1900. WATERS, Bryozoa from Franz Josef Land, Linnean Society Journal, vol. 28, pl. 9, fig. 11; pl. 12, fig. 5.—1902. HARMER, On the morphology of the Cheilostomata, Quarterly Journal of Microscopical Science, p. 301, figs. 48–52; p. 303, fig. 46.—1909. WATERS, Reports on the Marine Biology of the Sudanese Red Sea, The Bryozoa, Linnean Society Jonrnal, vol. 31, pl. 12, fig. 11.

The operculum is semilunar; the proximal border bears a slit or rimule which opens the compensatrix. The muscular attachments are two small, symmetrical tuberosities more or less removed from the border. When the proximal border of the aperture is linear it serves as a pivot for the operculum; when it is arched and the rimule very large the pivot of the operculum is formed by two projecting interior condyles.

The text figure gives a presentation of the anatomical structure of the species of this group.

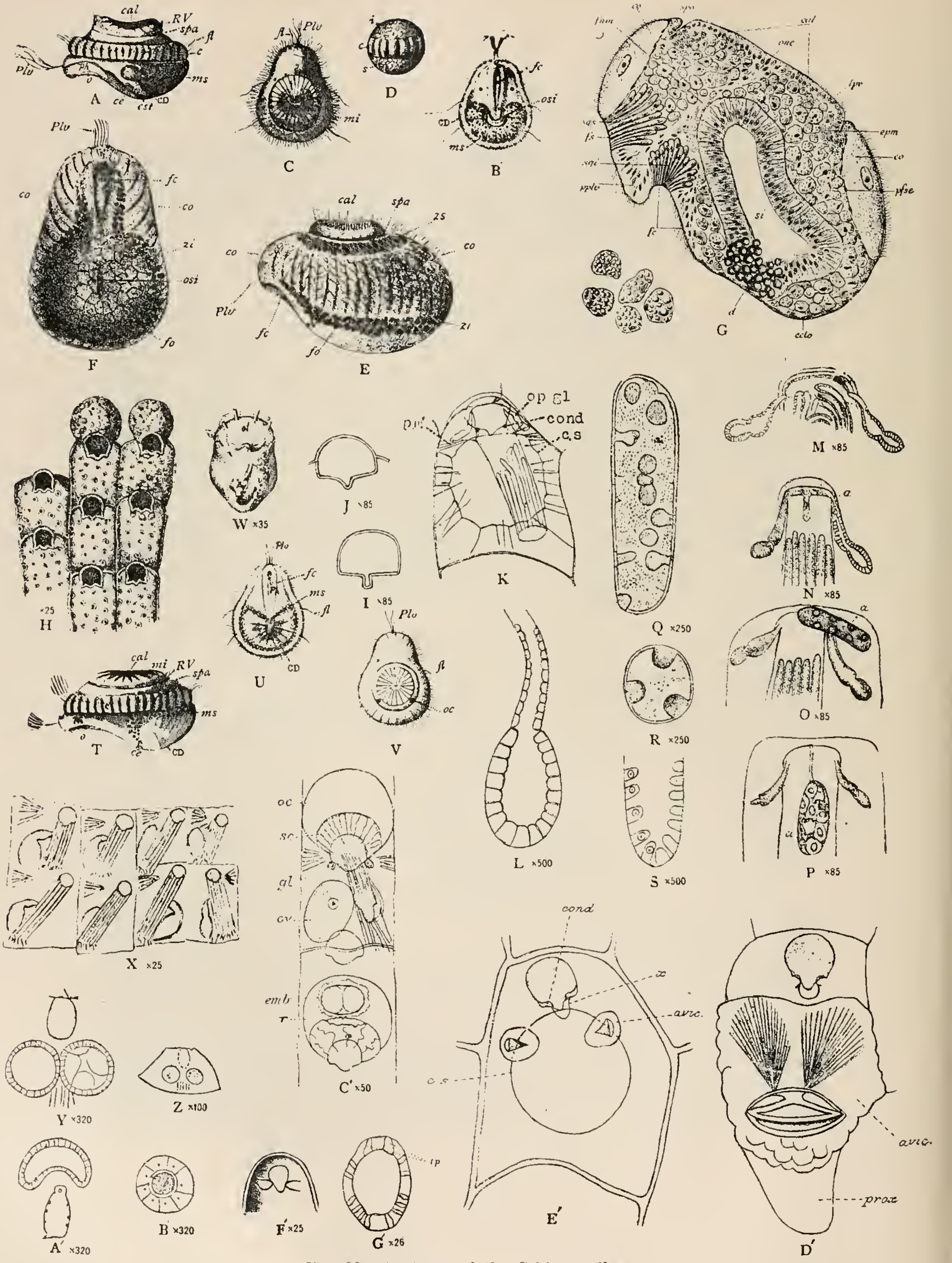
The classification was attempted successively in 1899, 1904, and 1913 by Waters in considering the muscular attachments of the operculum. In 1888 and 1903 Jullien formed many genera based on the nature of the frontal or on zoarial peculiarities. We will continue the work of these authors by considering the relationship of the operculum to the ovicell (passage of the eggs and escape of the larvae).

After the elimination of the genera created by Jullien and Levinsen, approved besides by Waters, a large number of very different species are still placed in the large genus *Schizoporella* Hincks, 1880.

The group of *Schizoporella viridis* forming a part of the genus *Watersipora* Neviani, 1895, is provided with an endozooecial ovicell, and belongs provisionally to the family Hippopodinidae.

The *Schizoporella sinuosa* group, in which the operculum does not correspond to the apertura and which is provided with a rimule spiramen, belongs to our family Stomachetosellidae.

The *Schizoporella unicornis* group is quite well characterized; the orifice of the ovicell is closed by a special membrane. This is our genus *Schizopodrella*. Hincks did not designate a type for his genus *Schizoporella;* the first species described is *Schizoporella unicornis* Johnston, 1847. We could (but it is not obligatory) preserve the name of *Schizoporella* for this group, but it seems to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A′ ×320
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G′ ×26

Fig. 99.—Anatomy of the Schizoporellae.

A–D. *Schizoporella spinifera* Johnston, 1847. A–C. Lateral (A), oral (B) and aboral (C) face of the larva. D. Embryo. (A–D after Barrois, 1877.) *cal*, calotte (terminal bud); *cd*, digestive cavity; *co*, corona; *est*, stomach; *fc*, ciliated cleft; *fl*, flagellum; *fo*, oral face; *I=i* aboral face; *mi*, aboral mesoderm; *ms*, *oral* (labial) mesoderm; *osi*, orifice of internal sac; *ph*, pharynx; *plv*, vibratile plume; *RV*, terminal bud; *S=s*, *oral* (vestibular) face; *spa*, palial furrow; *zc*, inferior pigmented zone; *zs*, superior pigmented zone.

E–S. *Schizobrachiella sanguinea* Norman, 1868. E, F. Larva from the left lateral face (E) and from the ventral face (F). G. Median sagittal section of the embryo. (E. F after Calvet, 1900.) *cal*, calotte (terminal bud); *co*, corona; *d*, vaginal diaphragm; *ecto*, oral ectocyst; *epm*, mesodermal thickening; *fc*, ciliated cleft; *fnm*, neuro muscular bundles; *fs*, superior fosette; *onc*, central nervous organ of embryo; *pfsc*, nerve plexus under ectoderm; *pplv*, papilla of vibratile plume; *sga*, superior glandular system; *si*, internal sac; *spa*, palial furrow; *sgi*, inferior glandular system. H. Zooecia and ovicells, × 25. (After Hincks, 1880.) I, J. Opercula, × 85. (After Waters, 1878.) K. Basal view of zooecium from which the basal wall has been removed. *c. s.*, compensation sac; *op. gl.*, opercular glands; *p. m.*, parietal muscles; *r.* rimule; *t*, tentacles. L–S. Glandular system. (After Waters, 1892.) L. Gland-like body, × 500. M. Opercular and distal end; the gland-like bodies are shown in section, × 85. N. Same as M, showing (*a*) growth from tissue at the opercular end. The right gland-like body is shown in section and with an attachment to the zooecial wall, × 85. O. The prolongation of tissue shown in fig. N. has now grown into the median body (*a*) which lies diagonally across the upper part of the zooecium, × 85. P. The same, hanging from the center, attached merely by a fine cord, × 85. Q. Longitudinal section of a median body showing the refracting masses, × 250. R. Transverse section of the same, × 250. S. Nucleated cells of glands, × 500.

T–X. *Schizopodrella* (*Schizoporella*) *unicornis* Johnston, 1847. T. Free larva, lateral view. U. Oral face of same. V. Aboral face of larva. W. Ancestrula with terminal bud and two lateral buds, × 35. (T–W after Barrois, 1877.) X. Sketch showing the diagonal position of the zooecia, × 25. (After Waters, 1908.)

Y–B′. *Schizopodrella* (*Schizoporella*) *nivea* Busk 1884. Avicularian glands of the small avicularia. (After Waters, 1913.) The two glands separated, × 320 (Y); the same, × 100 (Z); glands united, × 320 (A′); gland, × 320 (B′).

C′–E′. *Schizopodrella* (*Schizoporella*) *linearis* Hassall, 1841. C′. Two zooecia, × 50, figured near together but not in the same row, and placed together to save space. A sac-like structure (*sc*) is shown at the base of each ovicell (*oc*) but of the numerous muscles in this sac only about half of those in focus are drawn. It seems that the ovum (*ov*) passes into this sac which is then ruptured (*r*), and the ovum is pressed forward into the ovicell, where it segments. The small oral galnds are shown (*gl*). After Waters, 1913.) D′. Sketch showing a gigantic avicularium (*avc*); *prox*, proximal end of the zooecium, into which the polypide extends, beneath the avicularium. (After Harmer, 1902.) E′. Zooecium, showing the compensatrix (*c.s.*). The emargination of the frontal shield containing the sinus of the operculum enlarges as it passes through the thickness of the calcareous wall, so that its outline on the inner side of the frontal shield is represented by the line *x*. (After Harmer, 1902.)

F′. *Schizoporella gelida* Waters, 1904. Interior, showing condyles (denticles), × 25. (After Waters, 1904.)

G′. *Schizoporella magniporata* Nordgaard, 1906. Sketch, × 26, showing the distal (*tp*) and lateral dietellae. (After Nordgaard, 1906.)

us more useful to preserve it, at least provisionally, for all the species imperfectly studied and classed.

All the other species have the ovicell closed by the operculum and form a heterogeneous group.

The function of the avicularia is unknown, but it has certainly not the universality of the hydrostatic system. However, on many bryozoa, the avicularia appear to be indispensable, for they are constant in form and position. For example, the group of *Schizoporella auriculata* (genus *Schizomavella*) is ornamented by a very constant median avicularium.

On other species the avicularia occupy a lateral or eccentric position. They belong to the still poorly defined groups of *Schizoporella vulgaris*, including the fossil forms, *Eschara phymatopora* Reuss, 1869, and *Lepralia schizostoma* MacGillivray, 1898, of *Schizoporella argentea* with the fossil representative *Schizoporella terebrata* Maplestone, 1901, and of *Schizoporella spinifera.*

A number of *Schizoporellae* are absolutely deprived of avicularia; they have been divided into the genera *Phonicosia*, *Arthropoma*, and *Dakaria*, according to the special function of the rimule.

A rather important group appears to have a little chitinized operculum. The functions of this important organ are then assumed by the peristome specially developed; this is the curious genus *Metroperiella.* The group of Waters with large operculum does not appear a natural one to us.

### Genus SCHIZOPODRELLA Canu and Bassler, 1917.

1917. *Schizopodrella* Canu and Bassler, Synopsis of American Early Tertiary Cheilostome Bryozoa, Bulletin 96, United States National Museum, p. 40.

The ovicell is hyperstomial. It opens above the aperture by a special opening closed by a special membrane and without connection with the operculum; it surmounts this aperture without inclosing it. The inferior border of the aperture is somewhat concave and bears a narrow rimule. The frontal is a tremocyst direct or covering a very thin olocyst finely perforated. The muscular attachments are generally at a distance from the border of the operculum. There are oral glands. 16–21 tentacles.

*Genotype.*—*Schizopodrella* (*Lepralia*) *unicornis* Johnston, 1847.

*Range.*—Lutetian-Recent.

Waters in 1913 (p. 505) differentiated this genus without naming it. *Schizopodrella* differs from *Stephanosella* in the tremopores which ornament its frontal and ovicell. It differs from *Lacerna* in the absence of areolae.

The recent species of this genus are:

*Schizopodrella* (*Lepralia*) *unicornis* Johnston, 1847.
*Schizopodrella* (*Schizoporella*) *longirostris* Hincks, 1888.
*Schizopodrella* (*Lepralia*) *errata* Waters, 1879.
*Schizopodrella* (*Schizoporella*) *elmwoodiae* Waters, 1900.
*Schizopodrella* (*Schizoporella*) *nivea* Busk, 1884.
*Schizopodrella* (*Lepralia*) *linearis* Hassall, 1841.

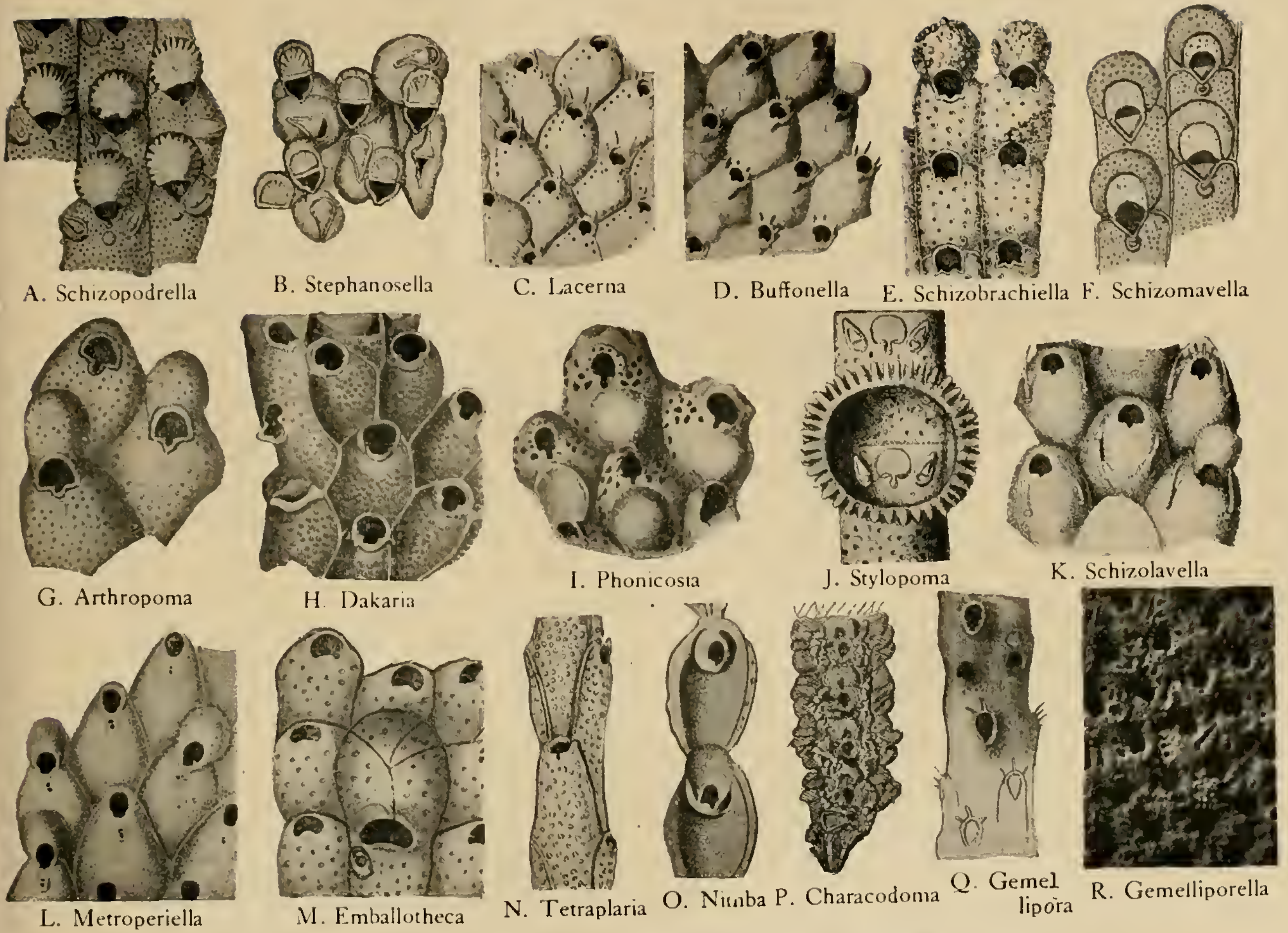
A. Schizopodrella
B. Stephanosella
C. Lacerna
D. Buffonella
E. Schizobrachiella
F. Schizomavella
G. Arthropoma
H. Dakaria
I. Phonicosia
J. Stylopoma
K. Schizolavella
L. Metroperiella
M. Emballotheca
N. Tetraplaria
O. Nimba
P. Characodoma
Q. Gemellipora
R. Gemelliporella

FIG. 100.—Genera of the subfamily Schizoporellae Canu and Bassler, 1917.

A. *Schizopodrella unicornis* Johnston, 1847, × 30. Recent.
B. *Stephanosella biaperta* Michelin, 1845, × 30. Recent.
C. *Lacerna hosteensis* Jullien, 1888, × 25. Recent.
D. *Buffonella ridleyi* MacGillivray, 1882, × 30. Recent.
E. *Schizobrachiella sanguinea* Norman, 1885, × 30. Recent.
F. *Schizomavella auriculata* Hassall, 1842, × 50. Recent.
G. *Arthropoma cecilii* Audouin, 1826 × 30. Recent.
H. *Dakaria chevreuxi* Jullien, 1904, × 20. Recent.
I. *Phonicosia jousseaumi* Jullien, 1888, × 25. Recent.
J. *Stylopoma spongites* Pallas, 1766. Recent
K. *Schizolavella vulgaris* Moll, 1803, × 25. Recent.
L. *Metroperiella lepralioides* Calvet, 1904, × 35. Recent.
M. *Emballotheca quadrata* MacGillivray, 1880, × 23. Recent.
N. *Tetraplaria australis* Tenison-Woods, 1878. Tertiary of Australia.
O. *Nimba pretexta* Jullien, 1904, × 25. Recent.
P. *Characodoma halli* Maplestone, 1900. Miocene of Australia.
Q. *Gemellipora glabra* Smitt, 1872. Recent.
R. *Gemelliporella vorax*, new species, × 20. Miocene of South Carolina.

### SCHIZOPODRELLA LINEA Lonsdale, 1845.

Plate 45, figs. 10–18.

1845. *Eschara linea* Lonsdale, Account of twenty-six species of Polyparia obtained from the Eocene Tertiary formation of North America, Quarterly Journal Geological Society London, vol. 1, p. 530, fig.

1862. *Escharinella ? linea* Gabb and Horn, Monograph of the fossil Polyzoa of the Secondary and Tertiary formations of North America, Journal of the Academy of Natural Sciences of Philadelphia, ser. 2, vol. 5, p. 140.

*Description.*—The zoarium is free, bilamellar; the two lamellae are inseparable. The zooecia are large, elongated, distinct, elliptical; the frontal is convex and formed by a thick tremocyst closely united with a very thin inner olocyst, the interior of which is very finely perforated. The aperture is semilunar; the proximal border is a little concave and bears a narrow rimule. The hyperstomial ovicell is salient, globular and smooth. Two small avicularia are symmetrically disposed on each border of the aperture; they have a fragile pivot; the beak is directed toward the median zooecial axis.

*Measurements.*—Aperture $\begin{cases} ha=0.15 \text{ mm. (including rimule).} \\ la=0.12 \text{ mm.} \end{cases}$

Zooecia $\begin{cases} Lz=0.75\text{–}0.90 \text{ mm.} \\ lz=0.45\text{–}0.65 \text{ mm.} \end{cases}$

*Variations.*—There are some zooecia which are narrow (fig. 12), some wide (fig. 13), and others very irregular. Often the zooecia are surrounded by a prominent thread (fig. 14). The ovicell is always smooth. This is a peculiarity which is very rare in the bryozoa, as the ovicell and the frontal are generally of the same nature. The small oral avicularia are very constant; sometimes there is one of them which is abortive (figs. 13, 14); the pivot (fig. 14) is very fragile and often missing on the fossils.

The interior is furnished with a thin perforated olocyst (fig. 17). Upon rubbing away the interior it may be noted that the tremopores are bound together by a system of small canals radiating from the median axis of the zooecia. Their intersection with the calcareous deposit over the tremopores form reticulations visible in tangential sections (fig. 16). The tremopores are funnel shaped and are much larger on the exterior than on the interior.

On account of the size of its fronds this is an easily recognized bryozoan.

*Affinities.*—This species is very close to *Schizopodrella unicornis* Johnston, 1847, but differs in its smaller, less prominent avicularia, which are turned toward the interior of the aperture and not toward the exterior of the zooecia.

It differs from *Schizopodrella viminea* Lonsdale, 1845, in its wider zooecia, and its two symmetrical avicularia.

It differs from *Schizopodrella marginata* in its micrometric dimensions which are twice as large, and in the presence of the two oral avicularia.

*Occurrence.*—Middle Jacksonian: Type-locality, Eutaw Springs, South Carolina (very common); near Lenuds Ferry, South Carolina (abundant); Wilmington, North Carolina (rare).

*Plesiotypes.*—Cat. No. 64052, U.S.N.M.

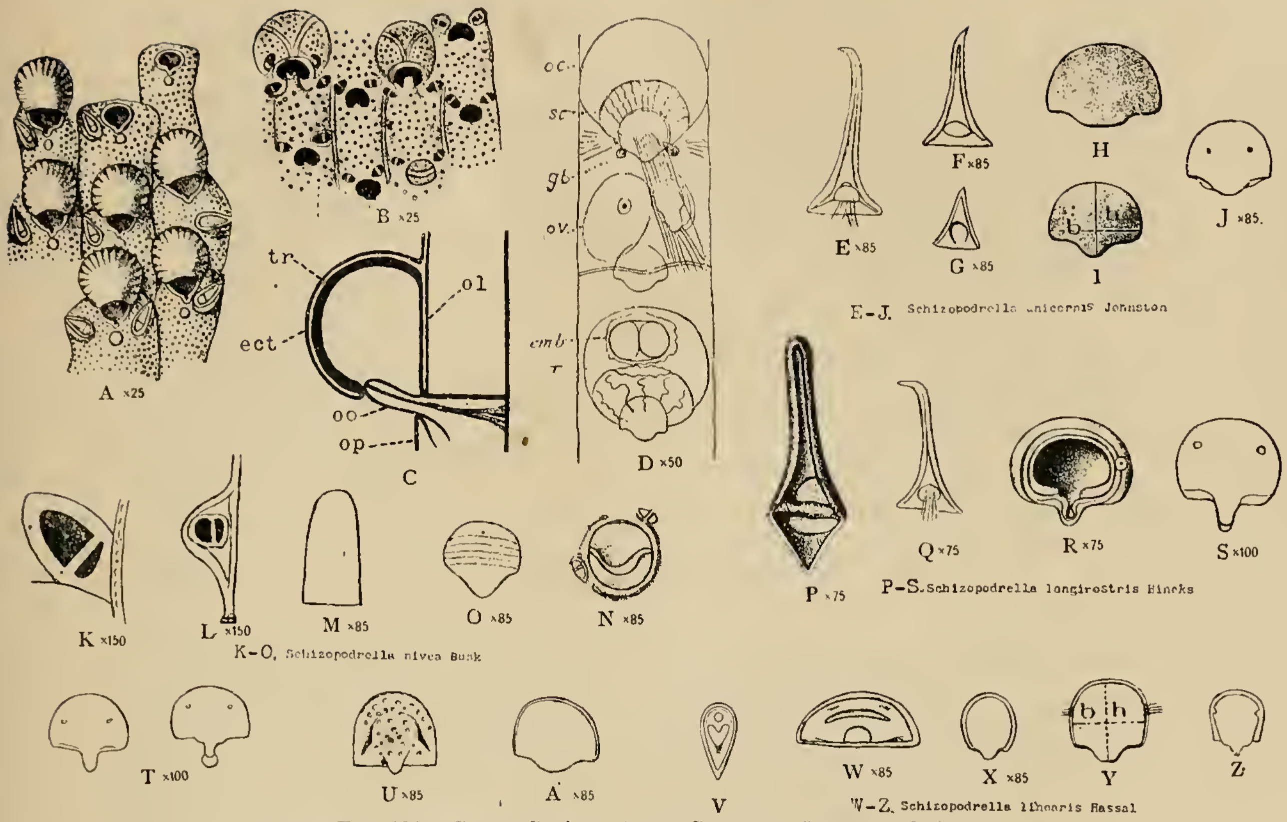
A ×25
B ×25
tr.
ect
ol
oo
op
C
oc
sc
gb
ov
emb
r
D ×50
E ×85
F ×85
G ×85
H
I
b
h
J ×85.
E–J. Schizopodrella unicornis Johnston
K ×150
L ×150
M ×85
O ×85
N ×85
K–O. Schizopodrella nivea Busk
P ×75
Q ×75
R ×75
S ×100
P–S. Schizopodrella longirostris Hincks
T ×100
U ×85
A' ×85
V
W ×85
X ×85
Y
Z
W–Z. Schizopodrella linearis Hassal

FIG. 101.—Genus *Schizopodrella* Canu and Bassler, 1917.

A. *Schizopodrella unicornis* Johnston, 1847. Zooecia with ovicells and avicularia, × 25. (After Hincks, 1880.)

B. *Schizopodrella nivea* Busk, 1884. Zooecia, × 25. (After Waters, 1913.)

C. Schematic section through the ovicell of *Schizopodrella unicornis* Johnston, 1847. (After Levinsen, 1909.) *ect*, ectocyst; *ol*, olocyst; *oo*, ovicell operculum; *op*, operculum; *tr*, tremocyst; *v*, vestibulum.

D. *Schizopodrella nivea* Busk, 1884. The two zooecia figured × 50, were near together, but not in the same row, and are placed together to save space. A sac-like structure (*sc*) is shown at the base of each ovicell (*oc*), but of the numerous muscles in this sac only about half of those in focus are drawn. It seems that the ovum (*ov*) passes into this sac, which is then ruptured (*r*), and the ovum is pressed forward into the ovicell, where it segments. The small oral glands are shown (*gb*).

E–J. *Schizopodrella unicornis* Johnston, 1847. E, F, G. Mandibles, × 85. H, I, J. Opercula, × 85. (After Waters, 1913, and Nordgaard, 1905.)

K–O. *Schizopodrella nivea* Busk, 1884. K. Basal avicularium, × 150. L. Lateral avicularium, × 150. M. Mandible, × 85. N. Oral aperture closed by calcareous wall. × 85. O. Operculum, × 85. (After Waters, 1913.)

P–S. *Schizopodrella longirostris* Hincks, 1886. P. Avicularium, × 75. Q. Mandible, × 75. R. Oral aperture × 75. S. Operculum, × 100. (P–S after Levinsen, 1909.)

T. *Stylopoma spongites* Pallas, 1766. Opercula, × 100. (After Levinsen, 1909.) (Introduced by error.)

U. *Schizopodrella elmwoodiae* Waters, 1900. Operculum, × 85. (After Waters, 1900.)

V–Z. *Schizopodrella linearis* Hassal, 1841. V, W. Mandibles, × 85. (After Levinsen and Waters.) X, Y, Z. Opercula, × 85. (After Waters and Nordgaard.)

A'. *Schizopodrella errata* (Waters, 1875). Operculum, × 85. (After Waters, 1879.)

### SCHIZOPODRELLA ? MARGINATA, new species.

Plate 44, figs. 11, 12.

*Description*.—The zoarium is free, bilamellar, with much compressed fronds. The zooecia are distinct elongated, rhomboidal, separated by a prominent thread; the frontal is flat and formed by a tremocyst with small pores. The aperture is very small and semilunar, its proximal border is intersected by a small rimule relatively wide and of little depth. On the margins there are two or three very simple, small avicularia.

*Measurements*.—Aperture $ha=0.09$ mm. $la=0.05$ mm. Zooecia $Lz=0.50$ mm. $lz=0.30$ mm.

*Affinities*.—This species is characterized by its very small dimensions. It differs from *Buffonella microstoma* in the presence of the frontal tremocyst and in its free zoarium.

*Occurrence*.—Middle Jacksonian (Castle Hayne limestone): Wilmington, North Carolina (very rare).

*Cotypes*.—Cat. No. 64046, U.S.N.M.

### SCHIZOPODRELLA VIMINEA Lonsdale, 1845.

Plate 45, figs. 1–9.

1845. *Eschara viminea* Lonsdale, Report on the Corals from the Tertiary formations of North America, Quarterly Journal Geological Society, London, vol. 1, p. 520, fig.

1845. *Eschara incumbens* Lonsdale, Report on the Corals from the Tertiary formations of North America, Quarterly Journal Geological Society, London, vol. 1, p. 529.

1862. *Eschara viminea* Gabb and Horn, Monograph of the Fossil Polyzoa of the Secondary and Tertiary formations of North America, Journal Academy Natural Sciences, Philadelphia, ser. 2, vol. 5, p. 116.

1862. *Eschara incumbens* Gabb and Horn, Monograph of the Fossil Polyzoa of the Secondary and Tertiary formations of North America, Journal Academy Natural Sciences, Philadelphia, ser. 2, vol. 5, p. 116.

1862. *Eschara texta* Gabb and Horn, Monograph of the Fossil Polyzoa of the Secondary and Tertiary formations of North America, Journal Academy Natural Sciences, Philadelphia, ser. 2, vol. 5, pl. 17, pl. 19, fig. 1.

*Description*.—The zoarium is free bilamellar, formed of two lamellae, back to back, and rarely separable; the fronds are wide, flat, or undulated. The zooecia are very long, fusiform, or cylindrical; the frontal is convex and formed of a tremocyst, with numerous pores in quincunx. The apertura is semilunar, transverse, with a straight proximal border, with a very small linear rimule; the peristome is very thin and hardly salient. The ovicell is hyperstomial, much embedded in the distal zooecia, quite large, globular, salient, smooth; its orifice, placed much above the apertura, is very large. Near the apertura, there is a triangular avicularium, the beak directed toward the exterior.

*Measurements*.—Apertura $\begin{cases} ha=0.10 \text{ mm.} \\ la=0.18 \text{ mm.} \end{cases}$ Zooecia $\begin{cases} Lz=0.80\text{–}1.00 \text{ mm.} \\ lz=0.30\text{–}0.45 \text{ mm.} \end{cases}$

*Variations.*—The oral sinus disappears frequently on account of the considerable thickening of the frontal (fig. 2), but it persists at the base of the peristomie and is always visible in the interior (fig. 8).

*Eschara incumbens* Lonsdale, 1845, is merely this same species provided with its ovicells. They are very large; their frontal is thickened considerably on the parietal olocyst—a very rare phenomenon in the Cheilostomes, where the ovicell is almost always of the same nature as the frontal. By dissecting the ovicell the apertura is always visible and very constant in form and size. The oral avicularium is not at all constant; it disappears over entire fronds when they have the aspect of *Eschara texta* Gabb and Horn, 1862. Another character common to the two species is "The alternate elevations and depressions of the cellular surface of this remarkable species give it, to the naked eye, very much the appearance of a woven fabric," quite visible in our figure 3, and noted in 1862 by Gabb and Horn.

According to the tangential section (fig. 6) the tremocyst does not appear to repose on a calcified olocyst.

*Affinities.*—This species differs from *Schizopodrella linea* Lonsdale, 1845, in its less zooecial width (*lz*=0.30–0.45 mm. instead of 0.45 mm.–0.65 mm.), and in a single avicularium placed below the apertura and not above it.

*Occurrence.*—Lower Jacksonian (Moodys marl): Jackson, Mississippi, (very common).

Middle Jacksonian: Wilmington, North Carolina (very common); Eutaw Springs, South Carolina (common, type locality); Baldock, Barnwell County, South Carolina (common); near Lenuds Ferry, South Carolina (common); 3½ miles north of Grovania, Georgia (rare); 3¼ miles south of Perry, Georgia (common); 17 miles northeast of Hawkinsville, Georgia (rare); one-half mile southeast of Georgia Kaolin Co. Mine, Twiggs County, Georgia (rare).

Jacksonian (Zeuglodon zone): Cocoa Post Office, Choctaw County, Alabama (rare).

*Plesiotypes.*—Cat. No. 64051, U.S.N.M.

### Genus STEPHANOSELLA Canu and Bassler, 1917.

1917. *Stephanosella* Canu and Bassler, Synopsis of American Early Tertiary Cheilostome Bryozoa, Bulletin 96, United States National Museum, p. 40.

The ovicell is hyperstomial and embedded in the distal zooecia. It opens above the aperture by an especial orifice. The frontal is a smooth olocyst. No spines. The ovicelled zooecia have a large aperture and their avicularium is frontal.

*Genotype.*—*Schizoporella* (*Lepralia*) *biaperta* Michelin, 1845.

*Range.*—Jacksonian-Recent.

Our genus does not exactly correspond to the *Schizoporella biaperta* group of Waters, 1913. We prefer to take into consideration the nature of the frontal rather than the muscular attachments, which are impossible to verify on the fossils. If the areolae were more frequently observed in the species of this genus, it would be preferable to unite them with the genus *Lacerna* Jullien, 1888.

*Stephanosella* differs from *Lacerna* in its oral avicularia and in the absence of spines.

The known fossil species of this genus are:

*Stephanosella* (*Lepralia*) *entomostoma* Reuss, 1847.
*Stephanosella* (*Lepralia*) *seriata* Reuss, 1874.
*Stephanosella strictifissa* MacGillivray, 1895.

The genotype *Schizoporella biaparta* Michelin, 1845, lives to-day off the Azores (Norman), in the waters of Florida (Smitt), and off the eastern coast of the United States (Osburn). The currents have also carried the species along the western coasts of the United States (Roberston).

The simultaneous occurrence in Europe and America of *Stephanosella* (*Schizoporella*) *entomostoma* Reuss, 1847, shows again that the equatorial currents were already in existence in the Vicksburgian age.

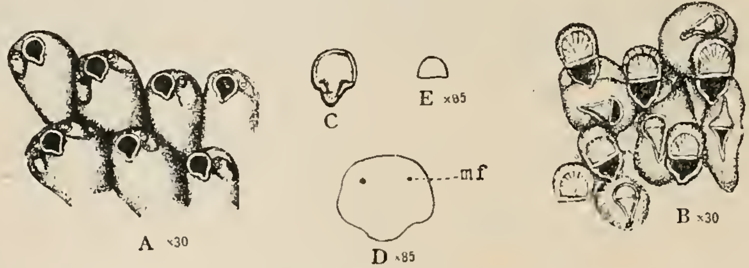

Fig. 102.—Genus *Stephanosella* Canu and Bassler, 1917.

A–D. *Stephanosella biaperta* Michelin, 1845. A. Zooecia, × 30. B. Zooecia with ovicells and avicularia, × 30. (After Hincks, 1880.) C. Operculum of the variety *divergens*. (After Norman, 1903.) D. Operculum, × 85. *mf*, muscular insertion.
E. Mandible, × 85. (After Nordgaard, 1906.)

### STEPHANOSELLA PARVIPORA, new species.

Plate 85, fig. 22.

*Description.*—The zoarium incrusts bryozoa. The zooecia are distinct, somewhat elongated, subhexagonal, irregular; the frontal is smooth, little convex, bordered by widely spaced, very small areolae. The aperture is very *small*, transverse, and is provided with a wide rimule. The ovicell is large, salient, surrounded by a collar. One or two irregular, oral avicularia are placed at different heights and deform the zooecia.

*Measurements.*—Aperture $\left\{\begin{array}{l} ha=0.04\text{–}0.045\text{ mm.}\\ la=0.06\text{–}0.07\text{ mm.}\end{array}\right.$ Zooecia $\left\{\begin{array}{l} Lz=0.35\text{ mm.}\\ lz=0.25\text{ mm.}\end{array}\right.$

*Affinities.*—The frontal of the ovicell is very fragile and does not always exist on the fossils; only the outer collar persists.

This species differs from *Stephanosella entomostoma* Reuss, 1847, in its much smaller aperture ($la=0.06$ mm. instead of 0.12 mm.). Its other micrometric dimensions are also much smaller than those of *Stephanosella* (*Schizoporella*) *biaperta* Michelin, 1845.

*Occurrence.*—Vicksburgian (Marianna limestone): Three miles southeast of Vosburg, Jasper County, Mississippi (rare).

*Holotype.*—Cat. No. 64270. U.S.N.M.

### STEPHANOSELLA ENTOMOSTOMA Reuss, 1847.

Plate 85, figs. 19–21.

1847. *Cellepora entomostoma* Reuss, Die fossilen Polyparien des Wiener Tertiarbeckens, Haidinger's naturwissenschaftliche Abhandlungen, vol. 2, p. 92, pl. 11, fig. 7.

1864. *Lepralia entomostoma* Reuss Zur Fauna der deutschen Oberoligocäns, Sitzungsberichte der k. Akademie der Wissenschaften, vol. 50, p. 27, pl. 13, fig. 6.

1874. *Lepralia entomostoma* Reuss, Die fossilen Bryozoen des Oesterreichisch-Ungarischen Miocäns, vol. 1, pl. 17, p. 4, fig. 11.

*Measurements.*—Aperture $\left\{\begin{array}{l} ha=0.08 \text{ mm.} \\ la=0.05 \text{ mm.} \end{array}\right.$ Zooecia $\begin{array}{l} Lz=0.32\text{–}0.36 \text{ mm.} \\ lz=0.20 \text{ mm.} \end{array}$

*Variations.*—The frontal is an olocyst absolutely smooth when there are no areolae (fig. 21); it is covered with small granulations of pleurocystal origin when very small, scattered areolae appear. More often there is only an oral avicularium; it is small, elliptical, without pivot on the ordinary zooecia (figs. 19, 20) but elongated, thin, with pivot on the ovicelled zooecia; moreover, on the latter it changes place, is removed from the aperture and becomes frontal (fig. 21).

The ovicell is globular, salient, and bears in front a fragile finely ribbed callosity of olocystal origin; it is bordered by a very thick circular collar. The aperture of the ovicelled zooecia is larger ($la=0.10$ mm. instead of 0.07 mm.).

The aperture is oblique, which, on account of perspective, diminishes the length of the rimule.

*Affinities.*—This species differs from *Stephanosella* (*Schizoporella*) *biaperta* Michelin, 1845, living and fossil, in the position of the avicularium, which is always placed below the aperture, and in its smaller micrometric dimensions.

It differs from *Stephanosella parvipora* in its larger aperture and in the avicularium, which is placed below the aperture.

*Occurrence.*—Vicksburgian (Marianna limestone): West bank Conecuh River, Escambia County, Alabama (common); Claiborne, Monroe County, Alabama (rare); 1 mile north of Monroeville, Alabama (very common).

*Geological distribution.*—Chattian of Germany (Reuss) and Tortonian of Austria-Hungary (Reuss).

*Plesiotypes.*—Cat. No. 64269, U.S.N.M.

### Genus LACERNA Jullien, 1888.

1888. *Lacerna* Jullien, Mission Scientifique du Cap Horn, p. 48.

The ovicell is hyperstomial and is provided with a special orifice. which can be closed by the operculum for the passage of the eggs. The aperture is arched anteriorly; its proximal border is straight, with a small, rounded rimule. The aperture and the rimule are surrounded by the same peristome, which is provided with spines. There is a vestibular arch. The frontal and the ovicell are formed of an olocyst surrounded with areolae, above which an incomplete and granular pleurocyst is deposited. 14 tentacles.

*Genotype.*—*Lacerna hosteensis* Jullien, 1888.

*Range.*—Lutetian-Recent.

The recent species of this genus are:
*Lacerna hosteensis* Jullien, 1888.
*Lacerna* (*Schizoporella*) *catoni* Busk, 1879.
*Lacerna* (*Schizoporella*) *ornata* Calvet, 1909.
*Lacerna* (*Schizoporella*) *insignis* Hincks, 1881.
The fossil species are:
*Lacerna* (*Lepralia*) *sequenzai* Reuss, 1869.
*Lacerna* (*Lepralia*) *süssi* Reuss, 1869.
*Lacerna* (*Schizoporella*) *fissa* Koschinsky, 1885.
*Lacerna* (*Lepralia*) *fuchsii* Reuss, 1874.
*Lacerna* (*Schizoporella*) *convexa* MacGillivray, 1895.
*Lacerna* (*Schizoporella*) *nitens* MacGillivray, 1895.

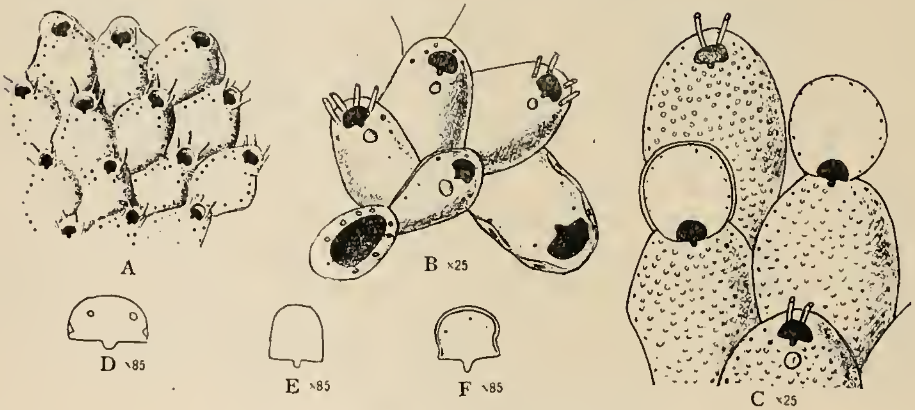

Fig. 103.—Genus *Lacerna* Jullien, 1888.

A–D. *Lacerna hosteensis* Jullien, 1888. A. Zooecia, × 25. (After Jullien, 1888.) B. Zooecia with ancestrula, × 25. C. Ovicelled zooecia, × 25. D. Operculum, × 85. (After Waters, 1904.)

E, F. *Lacerna eatoni* Busk, 1879. E. Operculum, × 85. (After Waters, 1904.) F. Operculum of the variety *areolata*, × 85. (After Calvet, 1910.)

*Lacerna* (*Schizoporella*) *nitidissima* Maplestone, 1901.
*Lacerna* (*Schizoporella*) *cavolini* Neviani, 1895.
*Lacerna* (*Schizoporella*) *ovalis* Maplestone, 1901.

This genus is very closely related to *Stephanosella*. *Lacerna* differs in the larger and more numerous areolae, the presence of spines, and the place of the avicularium below the aperture.

### LACERNA JACKSONENSIS, new species.

Plate 44, figs. 13–16.

*Description.*—The zoarium incrusts other bryozoa. The zooecia are distinct, very little elongated, separated by a furrow; the frontal is somewhat convex, smooth, and bordered by a line of large closely arranged areolae; a pleurocyst more or less granular and complete is deposited on the frontal, chiefly in the vicinity of the areolae. The aperture is semilunar; the proximal border is linear and bears a narrow, linear rather long rimule; the peristome is salient; it surrounds the aperture and its rimule and it bears anteriorly six hollow spines. The ovicell is large, salient, elongated, of the same nature as the frontal; it is formed of a smooth, orbicular callosity (olocyst) surmounted by a prominent collar, and by areolae; it is never closed by the operculum. The avicularium is triangular, long, salient, placed laterally below the aperture and deforming the zooecia; it is transverse or oblique; its point to the outside.

*Measurements.*—Aperture $\left\{\begin{array}{l} ha=0.15 \text{ mm.} \\ la=0.10 \text{ mm.} \end{array}\right.$ Zooecia $\left\{\begin{array}{l} Lz=0.45\text{–}0.50 \text{ mm.} \\ lz=0.30\text{–}0.40 \text{ mm.} \end{array}\right.$

*Variations.*—The avicularium is sometimes far removed from the aperture (fig. 13); it is transverse (fig. 13) or oblique (fig. 14).

The part of the peristome which surrounds the rimule forms an elegant festoon above the aperture.

The pleurocyst and olocyst are closely united. The smooth zooecia are young zooecia in which the subjacent olocyst is still visible. The pleurocystal calcification operates according to rule, the areolae toward the aperture with the formation of small, interareolar, incomplete costules.

On the ovicell the calcification is more regular and finer; the physiological use of this structure is unknown; the length is 0.25 mm.

*Affinities.*—This species differs from *Lacerna hexagonalis* in its small dimensions and the presence of the prominent festoon which surrounds the rimule.

It differs from *Lacerna seguenzai* Reuss, 1869, in the absence of the oral mucro, and from *Lacerna süssi* Reuss, 1869, in the place, the size, and the form of its avicularia.

*Occurrence.*—Lower Jacksonian (Moodys marl): Jackson, Mississippi (common).

*Cotypes.*—Cat. No. 64047, U.S.N.M.

### LACERNA HEXAGONALIS, new species.

Plate 44, figs. 17–20.

*Description.*—The zoarium incrusts Orbitoides, bryozoa, and shells. The zooecia are distinct, little elongated, *hexagonal;* the frontal is little convex, formed of an olocyst more or less covered by a pleurocyst and surrounded by a line of large areolae. The aperture is semilunar; the proximal border is linear and notched by a narrow, linear, rather long rimule; the peristome is salient, and surrounds at the same time the aperture and its rimule forming exteriorly an oval peristomice; the peristome bears six large, hollow spines. The ovicell is large, salient, elongated, of the same nature as the frontal; it is formed of a circular callosity surrounded by very small areolae and a thick, salient collar; it is often closed by the operculum when the latter opens. The avicularium is long, thin, triangular, little salient, disposed in the same manner as the zooecial walls, without pivot.

*Measurements.*—Aperture $\left\{\begin{array}{l} ha=0.125\text{–}0.15 \text{ mm.} \\ la=0.15\text{–}0.20 \text{ mm.} \end{array}\right.$ Zooecia $\left\{\begin{array}{l} Lz=0.65\text{–}0.72 \text{ mm.} \\ lz=0.50 \text{ mm.} \end{array}\right.$

*Variations.*—The calcification is here rather remarkable and more visible than in *Lacerna jacksonensis.* The frontal is an olocyst, entire and smooth (fig. 17); on the young zooecia; the pleurocyst develops at first over the areolae (fig. 18), then spreads over all the zooecia (fig. 20). As usual, the pleurocyst is irregularly granulated, quite variable in its texture and its deposits.

The calcification of the ovicell is absolutely identical. Originally the latter was formed by a thin olocyst thickened on its border into a circular crown; the frontal callosity is surrounded by very small areolae (fig. 17) and may be covered by a granular pleurocyst (fig. 20). On the young zooecia the operculum may never close the ovicell (fig. 17), but on the much calcified zooecia the operculum in opening may close the ovicell (fig. 20). Figure 20 presents a remarkable zooecium; for in the total regeneration an avicularium replaces a normal polypide.

The species appears to have some dietellae, variable in number (fig. 19).

*Affinities.*—This species differs from *Arthropoma* (*Lepralia*) *speyeri* Reuss, 1864, in which the aperture is identical in its nonporous frontal and its larger avicularium.

It differs from *Lacerna jacksonensis* in its larger micrometric dimensions and its oval and nonfestooned peristome.

It differs from *Lacerna* (*Schizoporella*) *nitens* MacGillivray, 1895, in its deeper rimule and in the point of the avicularium turned toward the bottom and not toward the top.

*Occurrence.*—Vicksburgian (Marianna limestone): Salt Mountain, 5 miles south of Jackson, Alabama (rare); west bank of Conecuh River, Escambia County, Alabama (rare); near Claiborne, Monroe County, Alabama (rare); Murder Creek, east of Castlebury, Conecuh County, Alabama (rare); 1 mile north of Monroeville, Alabama (rare).

Upper Jacksonian (Ocala limestone): Chipola River, east of Marianna, Florida.

*Cotypes.*—Cat. Nos. 64048, 64049, U.S.N.M.

### Genus BUFFONELLA Jullien, 1888.

1888. *Buffonella* Jullien, Mission scientifique du Cap Horn, vol. 6, Zoologie, p. 47.

The operculum in opening closes the ovicell. The aperture is semilunar; its proximal border is straight and bears a rimule at its middle. The frontal and ovicell are absolutely smooth. The operculum has a wide sinus and two muscular points distant from the border. In front of the aperture there is often a small avicularian chamber.

*Genotype.*—*Buffonella* (*Schizoporella*) *ridleyi* MacGillivray, 1882.

*Range.*—Senonian-Recent.

The recent species of this genus are according to Waters:

*Buffonella* (*Schizoporella*) *ridleyi* MacGillivray, 1882.

*Buffonella* (*Schizoporella*) *simplex* D'Orbigny, 1833.
*Buffonella* (*Schizoporella*) *rimosa* Jullien, 1888.
*Buffonella* (*Schizoporella*) *marsupifera* Busk, 1884.
*Buffonella* (*Schizoporella*) *rumida* Hincks, 1881.
*Buffonella* (*Schizoporella*) *levata* Hincks, 1882.
*Buffonella* (*Schizoporella*) *laevigata* Waters, 1889.
*Buffonella* (*Schizoporella*) *edwardsiana* D'Orbigny, 1839.
*Buffonella* (*Escharella*) *stylifera* Levinsen, 1886.
*Buffonella* (*Schizoporella*) *hexagona* Nordgaard, 1905.

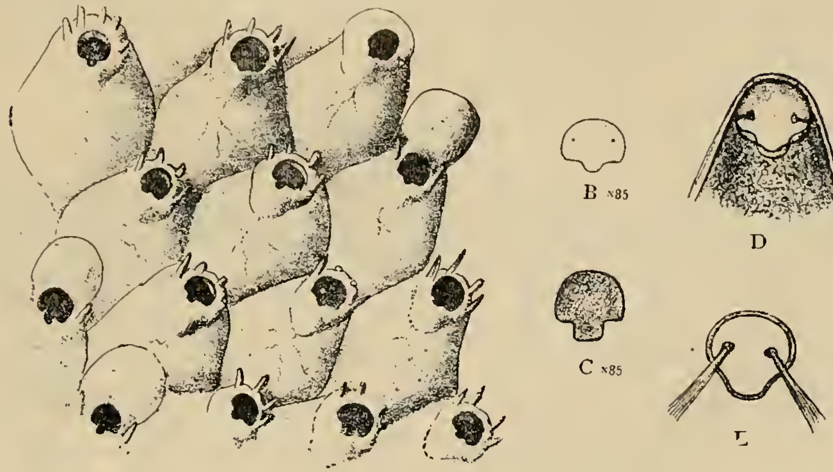

Fig. 104.—Genus *Buffonella* Jullien, 1888.

A, B. *Buffonella ridleyi* MacGillivray, 1882. A. Zooecia, × 50. (After Jullier, 1888.) B. Operculum, × 85. (After Waters, 1904.)

C. *Buffonella hexagona* Nordgaard, 1905. Operculum, × 85. (After Nordgaard.)

D, E. *Buffonella stylifera* Levinsen, 1886. D. Aperture of zooecium. E. Operculum. (After Levinsen, 1886.)

The known fossil species of the genus are:
*Buffonella* (*Lepralia*) *incisa* Reuss, 1874.
*Buffonella* (*Lepralia*) *pauper* Reuss, 1874.
*Buffonella* (*Schizoporella*) *nuda* Canu, 1908.
*Buffonella* (*Schizoporella*) *crenulata* MacGillivray, 1904.
*Buffonella* (*Schizoporella*) *arachnoides* MacGillivray, 1882.
*Buffonella* (*Schizoporella*) *clerici* Neviani, 1895.
*Buffonella* (*Schizoporella*) *carinata* Hennig, 1892.

### BUFFONELLA HEXAGONALIS, new species.

Plate 46, fig. 1.

*Description.*—The zoarium is formed of many superposed lamellae and incrusts stones. The zooecia are distinct, elongated, *hexagonal*, separated by a prominent thread; the frontal is convex, smooth, with the radial nerves visible by transparency. The aperture is small and bears on its proximal border a rather wide triangular rimule. Above the aperture there are two small, simple avicularia.

*Measurements.*—Aperture $\left\{\begin{array}{l} ha=0.12 \text{ mm.} \\ la=0.10 \text{ mm.} \end{array}\right.$ Zooecia $\left\{\begin{array}{l} Lz=0.65\text{–}0.75 \text{ mm.} \\ lz=0.45\text{–}0.50 \text{ mm.} \end{array}\right.$

*Affinities.*—This species differs from *Buffonella rhomboidalis* in its longer zooecia, in the salient separating thread, and the presence of two small supraoral avicularia.

The same characters also differentiate it from *Buffonella incisa* Reuss, 1874.

*Occurrence.*—Middle Jacksonian (Castle Hayne limestone): Wilmington, North Carolina (rare).

*Holotype.*—Cat. No. 64053, U.S.N.M.

### BUFFONELLA RHOMBOIDALIS, new species.

Plate 46, fig. 2.

*Description.*—The zoarium incrusts bryozoa. The zooecia are distinct, elongated *rhomboidal*, separated by a furrow; the frontal is convex and absolutely smooth. The aperture is small, without peristome; the rimule is large and rectangular.

*Measurements.*—Aperture $\left\{\begin{array}{l} ha=0.12 \text{ mm.} \\ la=0.10 \text{ mm.} \end{array}\right.$ Zooecia $\left\{\begin{array}{l} Lz=0.55\text{–}0.65 \text{ mm.} \\ lz=0.40\text{–}0.50 \text{ mm.} \end{array}\right.$

*Affinities.*—This species resembles *Buffonella incisa* Reuss, 1874, very much, in its extreme simplicity of structure. It differs from it only in its larger micrometric measurements ($Lz=0.55\text{–}0.65$ mm. instead of 0.36–0.40 mm.).

*Occurrence.*—Middle Jacksonian (Castle Hayne limestone): Wilmington, North Carolina (very rare).

*Holotype.*—Cat. No. 64054, U.S.N.M.

### BUFFONELLA MICROSTOMA, new species.

Plate 46, fig. 3.

*Description.*—The zoarium incrusts shells. The zooecia are very *small*, elongated, distinct; the frontal is smooth and convex. The aperture is very small; the rimule is wide and triangular. The ovicell is globular, salient, and smooth; it opens above the aperture by a small slit; it may be closed by the operculum.

*Measurements.*—Aperture $\left\{\begin{array}{l} ha=0.06 \text{ mm.} \\ la=0.06 \text{ mm.} \end{array}\right.$ Zooecia $\left\{\begin{array}{l} Lz=0.35 \text{ mm.} \\ lz=0.20 \text{ mm.} \end{array}\right.$

*Affinities.*—This species differs from *Buffonella incisa* Reuss, 1874, in its slightly smaller micrometric dimensions and in its rimule, which is triangular and not rectangular. Moreover, the European fossil sometimes bears a small, lateral avicularium, which we have not observed on the American specimens.

*Occurrence.*—Upper Jacksonian (Ocala limestone): Chipola River, east of Marianna, Florida (very rare); Old Factory, 1½ miles above Bainbridge, Georgia (rare).

*Holotype.*—Cat. No. 64055, U.S.N.M.

### Genus ARTHROPOMA Levinsen, 1909.

1909. *Arthropoma* Levinsen, Morphological and Systematic Studies on the Cheilostomatous Bryozoa, p. 332.

The ovicell is hyperstomial and always closed by the operculum. The frontal is a tremocyst with scattered pores. The operculum bears a mobile, small tongue in the middle of the straight proximal border. The rimule of the aperture is straight and rectangular.

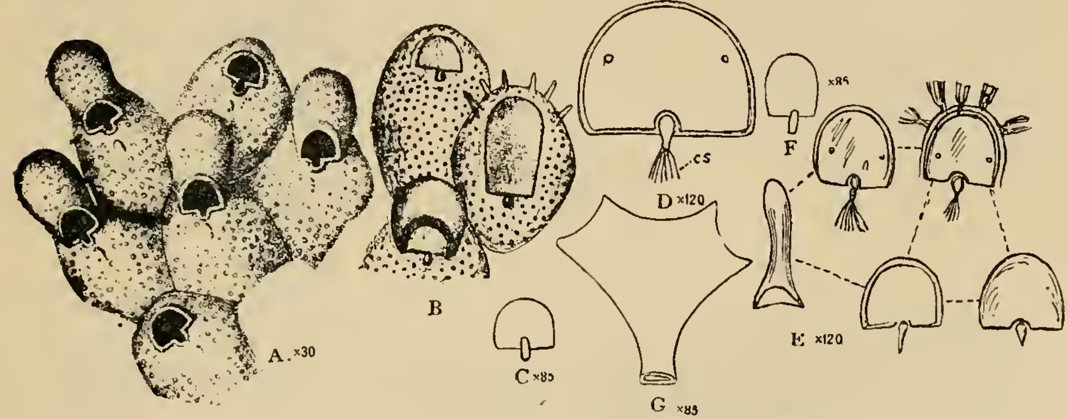

Fig. 105.—Genus *Arthropoma* Levinsen, 1909.

A, D. *Arthropoma ceeilii* Audouin, 1826. A. Zooecia, × 30. (After Hincks, 1880.) B. Avicularian zooecia. (After Kirkpatrick.) C. Operculum with its mobile tongue, × 85. (After Waters, 1904.) D. Operculum, × 120. (After Busk, 1884.) *cs.*, connected part of the compensatrix, which by foldings has assumed the longitudinally striated appearance.

E. *Arthropoma circinata* MacGillivray, 1868. Operculum and mandible, × 120. (After Busk, 1884.)

F, G. *Arthropoma pcsanseris* Smitt, 1879. Operculum and mandibles, × 85. (After Waters, 1899.)

*Genotype.*—*Arthropoma* (*Flustra*) *cecilii* Savigny-Audouin (1812) 1826.

*Range.*—Jacksonian-Recent.

The little mobile tongue of the operculum is attached to the compensatrix. This is the only character which differentiates this genus from *Phonicosia* Jullien, 1888, and if this be judged insufficient, it will be necessary to reunite the two genera under the latter name, which has the right of priority.

The mobility of the little tongue is evidently intended to protect from rupture the compensatrix, which is an extremely fragile organ.

Kirkpatrick has discovered a zooecium transformed into an interzooecial avicularium with special mandible. Such zooecia are not rare in other genera and we have sometimes noted them on the fossil forms.

The recent species of this genus are according to Waters, 1904, and Levinsen, 1909:

*Arthropoma* (*Flustra*) *cecilii* Savigny-Audouin (1812) 1826.

*Arthropoma* (*Hippothoa*) *pesanseris* Smitt, 1872.

*Arthropoma* (*Lepralia*) *circinata* MacGillivray, 1868.

Among the fossil species we may doubtfully cite *Arthropoma* (*Lepralia*) *speyeri* Reuss, 1865.

### ARTHROPOMA METULA, new species.

Plate 46, fig. 18.

*Description.*—The zoarium is free, bilamellar. The zooecia are elongated, distinct, in the form of *quills;* the frontal is convex and is a tremocyst with very small pores. The aperture is transverse; the proximal border is linear and bears a small rectangular rimule. The ovicell is very large, salient, globular, smooth; its orifice is very regular and is closed by the operculum itself. The avicularium is placed laterally below and close to the aperture; it is elliptical and salient; two lateral denticles serve as pivot.

*Measurements.*—Aperture $\begin{cases} ha=0.20 \text{ mm.} \\ la=0.20 \text{ mm.} \end{cases}$ Zooecia $\begin{cases} Lz=0.85 \text{ mm.} \\ lz=0.25 \text{ mm.} \end{cases}$

Ovicell $\begin{matrix} hov=0.30 \text{ mm.} \\ lov=0.45 \text{ mm.} \end{matrix}$

*Affinities.*—This species differs from *Arthropoma speyeri* Reuss, 1865, in its much larger and higher placed avicularium. This latter species is of Tongrian age (to be exact, from the Rupelian). It is remarkable to note that this genus appears almost simultaneously in Europe and America. The figured specimen is the only one which has been found.

*Arthropoma metula* differs from the recent *Schizoporella acuminata* Hincks, 1881, in its transverse and not straight avicularia and probably in the nature of the ovicell.

*Occurrence.*—Middle Jacksonian (Castle Hayne limestone): Wilmington, North Carolina (very rare).

*Holotype.*—Cat. No. 64061, U.S.N.M.

### Genus PHONICOSIA Jullien, 1888.

1888. *Phonicosia* JULLIEN, Mission scientifique du Cap Horn, vol. 6, Zoology, p. 51.

Orifice with posterior lip, straight, and bearing an elongated notch at its middle, with the extremity cut squarely. (Translation after Jullien.)

*Genotype.*—*Phonicosia jousseaumi* Jullien, 1888. Recent.

Waters, 1904, remarked that the genus *Phonicosia* was described from one small dead specimen, without opercula. The published figure does not permit the observation of the closing of the ovicell by the operculum, and we therefore leave to the genus *Phonicosia* the limits established by its author.

### SCHIZOBRACHIELLA, new genus.

The ovicell is hyperstomial and closed by the operculum. The frontal is a tremocyst. The operculum bears a straight poster notched by a small, narrow, rounded rimule. The tongue of the operculum is rigid and is not attached to the compensatrix; the muscular attachments are placed near the border. No avicularia.

*Genotype.—Schizobrachiella* (*Hemeschara*) *sanguinea* Norman, 1868. Range: Helvetian—Recent.

The recent species of this genus are:

*Schizobrachiella* (*Hemeschara*) *sanguinea* Norman, 1868.
*Schizobrachiella* (*Lepralia*) *candida* Stimpson, 1853.
*Schizobrachiella* (*Schizoporella*) *levinseni* Nordgaard, 1905.

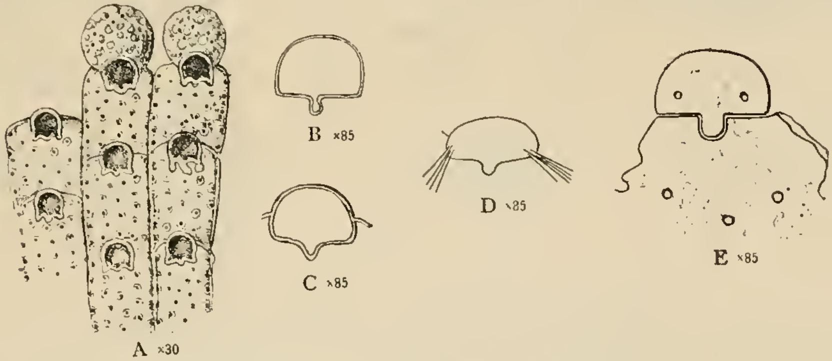

FIG. 106.—*Schizobrachiella*, new genus.

A–D. *Schizobrachiella sanguinea* Norman, 1868. A, Zooecia, × 30. (After Hincks, 1880.) B, C. Operculum, × 85. (After Waters, 1879.) D. Operculum, × 85. (After Nordgaard, 1905.)

E. *Schizobrachiella levinseni* Nordgaard, 1905. Operculum, × 85. (After Nordgaard, 1905.)

The known fossil species are:

*Schizobrachiella* (*Lepralia*) *goniostoma* Reuss, 1847.
*Schizabrachiella* (*Lepralia*) *granoso-porosa* Reuss, 1874.
*Schizobrachiella* (*Lepralia*) *crassipora* Reuss, 1874.
*Schizobrachiella* (*Schizoporella*) *alata* MacGillivray, 1895.
*Schizobrachiella* (*Schizoporella*) *subsinuata* MacGillivray, 1895.

This genus differs from *Dakaria* Jullien, 1904, in a much smaller rimule, in the muscular attachments very near the border of the operculum, and in the absence of interior condyle.

This genus differs from *Schizolavella* and *Schizomavella* in the absence of avicularia.

### Genus SCHIZOMAVELLA Canu and Bassler, 1917.

1917. *Schizomavella* CANU and BASSLER, Synopsis of American Early Tertiary Cheilostome Bryozoa, Bulletin 96, United States National Museum, p. 40.

The operculum closes the ovicell. The muscular attachment is generally in the immediate vicinity of the border of the operculum. The rimule is wide and arched. The frontal is a tremocyst. A median avicularium occurs on the front wall. There are small oral glands. 23 tentacles.

*Genotype.*—*Schizomavella* (*Lepralia*) *auriculata* Hassall, 1842.

*Range.*—Jacksonion-Recent.

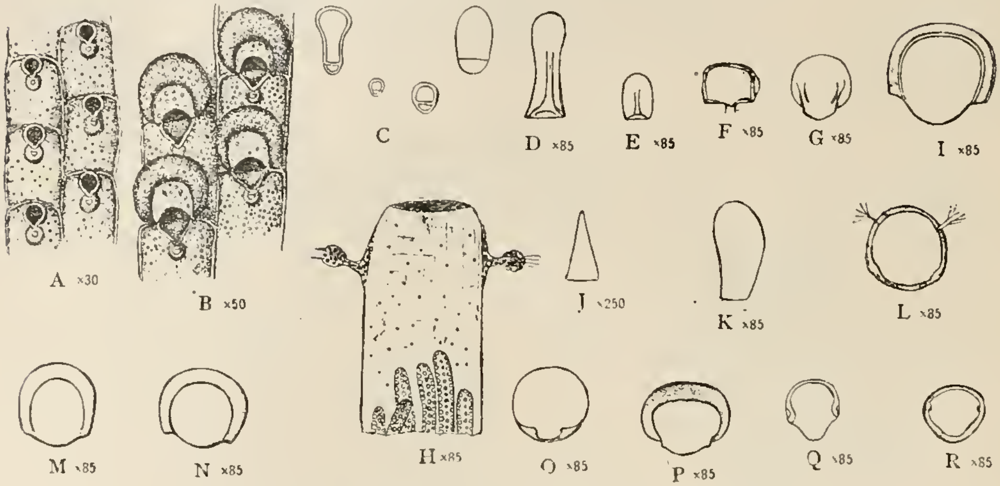

FIG. 107.—Genus *Schizomavella* Canu and Bassler, 1917.

A–H. *Schizomavella auriculata* Hassal, 1842. A. Zooecia, × 30. B. Zooecia with ovicells, × 50. C. Avicularia. (After Hincks, 1880.) D, E. Avicularian mandibles, × 85. F. Operculum, × 85. (After Waters, 1879.) G Operculum, × 85. (After Norman, 1903.)

H, I. *Schizomavella reticulato punctata* Hincks, 1877. H. Tentacular sheath with oral glands attached near the oral aperture and connected to the lateral walls, × 85. (After Waters, 1900.) I. Operculum, × 85. (After Nordgaard, 1906.)

J–L. *Schizomavella montferrandi* Savigny-Audouin, 1826. J, K. Mandibles. × 250 and × 85. L. Operculum, × 85. (After Waters, 1908.)

M. *Schizomavella porifera* Smitt, 1867. Operculum, × 85. (After Nordgaard, 1905.)

N–P. *Schizomavella lineata* Nordgaard, 1895. N. Operculum, × 85. O. Apertura, × 85. P. Operculum, × 85. (After Nordgaard, 1905.)

Q, R. *Schizomavella ambita* Waters, 1889. Q. Operculum, × 85. (After Waters, 1889.) R. Operculum, × 85. (After Calvet, 1904.)

The recent species are:

*Schizomavella* (*Schizoporella*) *harmsworthi* Waters, 1900 (=*Schizoporella reticulata punctata* Hincks, 1877).

*Schizomavella* (*Lepralia*) *galeata* Busk, 1859.

*Schizomavella* (*Flustra*) *montferrandi* Savigny-Audouin, 1826.

*Schizomavella* (*Schizoporella*) *lineata* Nordgaard, 1895.

*Schizomavella* (*Escharella*) *porifera* Smitt, 1867.

*Schizomavella* (*Schizoporella*) *ambita* Waters, 1889.

*Schizomavella* (*Schizoporella*) *scabra* Waters.

*Schizomavella* (*Schizoporella*) *fayalensis* Calvet, 1903.

*Schizomavella* (*Lepralia*) *auriculata* Hassall, 1842.

The fossil species are:

*Schizomavella* (*Schizoporella*) *lata* MacGillivray, 1895.

*Schizomavella* (*Schizoporella*) *plagiostoma* MacGillivray, 1895.

Levinsen in 1909, thought that median avicularia characterized the Smittinidae and that they might not exist in the Escharellidae. The Schizoporellae provided with a median avicularium might be reunited with the Smittinidae under the name of *Smittina*. The work of Harmer in 1902[1] showed that in *Schizoporella linearis*, the compensatrix and the hydrostatic system are analogous to those of the other *Schizoporella* and are notably different from those of *Smittina trispinosa*. Under these conditions we think we must maintain the primitive nomenclature. To facilitate the determination we have created the genus *Schizomavella* for the species provided with a very constant median avicularium.

The distinction between *Schizomavella* and certain species of *Hippoporina* is easy to make on the recent specimens by an examination of the muscular attachments on the operculum. On the fossil forms, the interior may furnish some useful points, but very often the problem is insoluble, so we must content ourselves with simple comparisons.

### SCHIZOMAVELLA GRANULIFERA, new species.

Plate 46, figs. 4–12.

*Description.*—The zoarium is free, with flat or undulated fronds formed of two lamellae, back to back, and inseparable. The zooecia are distinct, elongated, fusiform, separated by a furrow or a prominent thread; the frontal is convex, ornamented with small tremopores and small *granulations*. The aperture is transverse, elliptical; the rimule is very wide and separated from the anter by two small cardelles. The aperture of the ovicelled zooecia is larger. The ovicell is globular, very salient, ornamented by the same tremocyst as the frontal; it is hyperstomial, but always closed by the operculum. The median avicularium is small, round or triangular, adjacent to the rimule.

*Measurements.*—Aperture $\left\{\begin{array}{l} ha=0.10\text{–}0.12 \text{ mm.} \\ la=0.12\text{–}0.14 \text{ mm.} \end{array}\right.$ Zooecia $\left\{\begin{array}{l} Lz=0.54\text{–}0.70 \text{ mm.} \\ lz=0.34\text{–}0.50 \text{ mm.} \end{array}\right.$

*Variations.*—This species is very variable and its study has given us much trouble. The numerous specimens collected at many localities permit the recognition of the principal variations. The micrometric dimensions vary in unusual proportions; the zooecial length varies from 0.50 mm. to 0.80 mm. and the width from 0.30 to 0.52 mm. It is the same with the aperture, the dimensions of which, rather fixed on a single specimen, vary a great deal, according to localities. The frontal granulations are attenuated (fig. 10) or very salient (figs. 5, 8). The zooecial margins are sometimes very salient (fig. 10), but they are wanting most of the time (figs. 6, 8). The avicularium is generally round, but it may be much removed from the aperture and become triangular (fig. 9). The ovicell covers much of the aperture (fig. 7); it is therefore always closed by the operculum; meanwhile the orifice of the aperture persists in the interior (fig. 8); we have come to the conclusion that the operculum is lowered to allow the escape of the larvae.

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[1] 1902. Harmer, on the Morphology of the Cheilostomata, Quarterly Journal Microscopical Science, new ser., vol. 46, p. 301, pl. 17, figs. 42, 46, 48.

The tangential section (fig. 12) reveals clearly a tremocyst surmounting an olocyst closely united with it; the tremopores are very small and wide open. In the interior (fig. 11) the olocyst appears absolutely smooth, but when greatly magnified it is easy to distinguish the small pores corresponding to the tremopores.

*Affinities.*—This species differs from *Dakaria laxata* in its bilamellar zoarium and its smaller zooecial width, always less than 0.50 mm. instead of 0.60 mm. It differs from *Schizomavella elongata* in its lesser zooecial length, which is 0.70 mm. instead of 1.00 mm.

*Occurrence.*—Middle Jacksonian: Baldock, Barnwell County, South Carolina (very common); 12 miles southeast of Marshallville, Georgia (rare); 3¼ miles south of Perry, Georgia (rare); Rich Hill, Georgia (rare); 5¼ miles southeast of Knoxville, Georgia (rare); 18 miles east of Wrightsville, Georgia (rare); ½ mile southeast of Georgia Kaolin Company Mine, Twiggs County, Georgia (rare); 3½ miles north of Grovania, Georgia (rare); Wilmington, North Carolina (rare).

Upper Jacksonian (Ocala limestone): Chipola River, east of Marianna, Jackson County, Florida (common).

*Cotypes.*—Cat. No. 64058, U.S.N.M.

### SCHIZOMAVELLA GRANULOSA, new species.

Plate 46, figs. 13–16.

*Description.*—The zoarium incrusts bryozoa. The zooecia are elongated, distinct, fusiform; the frontal is little convex and formed of a *granular* tremocyst with very small pores. The aperture is formed of a semilunar anter and of a wide rounded rimule, separated by two inner condyles. The ovicell is very large, salient, formed of a large area surrounded by a small, salient collar; it entirely surrounds the aperture, but without forming a peristomie. The median avicularium is quite small, little prominent in the immediate vicinity of the aperture.

*Measurements.*—Aperture $\begin{cases} ha = 0.10 \text{ mm.} \\ la = 0.08\text{–}0.09 \text{ mm.} \end{cases}$ Zooecia $\begin{cases} Lz = 0.60 \text{ mm.} \\ lz = 0.40 \text{ mm.} \end{cases}$

*Affinities.*—The granular frontal is characteristic of this species; it resembles strangely in its granulations, in its bordered ovicell, and in its avicularium, placed near the aperture, the recent *Schizoporella marsupifera* Busk, 1884. It differs from the latter only in its more elongated zooecia and its nontransverse aperture.

We have observed (fig. 15) a regenerated avicularian zooecium in the interior of a primitive zooecium, where another one has succeeded it with a very small mandible.

*Occurrence.*—Upper Jacksonian (Ocala limestone): Old Factory, 1½ miles above Bainbridge, Georgia (rare).

*Cotypes.*—Cat. No. 64059, U.S.N.M.

### **SCHIZOMAVELLA ELONGATA,** new species.

Plate 46, fig. 17.

*Description.*—The zoarium is free, formed of two lamellae, back to back and inseparable; the zooecia are distinct, very *elongated*, fusiform, separated by an improminent thread; the frontal is flat and ornamented with small, wide open tremopores. The aperture is suborbicular; the rimule is very wide, concave, scarcely distinct from the anter. The ovicell is globular and salient, ornamented with a tremocyst analogous to that of the frontal. The median avicularium is small, triangular, without salient beak and imbedded in a cavity.

*Measurements.*—Aperture $\left\{\begin{array}{l} ha=0.10\text{ mm.}\\ la=0.10\text{ mm.}\end{array}\right.$ Zooecium $\left\{\begin{array}{l} Lz=1.10\text{ mm.}\\ lz=0.30\text{ mm.}\end{array}\right.$

*Affinities.*—This species is characterized by its very great zooecial length. We have observed two calcified zooecia; the aperture is covered by the tremocyst and replaced by a small pore. The physiologic rôle of such zooecia is unknown to us.

*Occurrence.*—Middle Jacksonian: Three and one-half miles north of Grovania, Georgia (rare).

*Holotype.*—Cat. No. 64060, U.S.N.M.

### **SCHIZOMAVELLA ARBOREA,** new species.

Plate 86, figs. 1–6.

*Description.*—The zoarium is free, *arborescent*, rectangular, or cylindrical. The zooecia are disposed in four longitudinal rows, alternating and placed back to back; they are hexagonal, very little elongated, separated by a prominent thread. The frontal is a direct tremocyst with large pores. The aperture is small, oblique and formed of a semilunar anter and of a very wide rimule of little depth. The ovicell is large, globular, salient, punctate; it is closed by the zooecial operculum which is larger on the ovicelled zooecia. The median avicularium is elliptical, salient, separated into two parts by a wide pivot.

*Measurements.*—Aperture $\left\{\begin{array}{l} ha=0.10\text{ mm.}\\ la=0.10\text{ mm.}\end{array}\right.$ Zooecia $\left\{\begin{array}{l} Lz=0.80\text{ mm.}\\ lz=0.72\text{ mm.}\end{array}\right.$

*Variations.*—The median avicularium is very variable on the same fragment; it is quite small ($l=0.08$ mm.) or very long ($l=0.25$ mm.), but it always remains elliptical (figs. 2, 5).

The zoarium is square (figs. 2, 6) or quite rounded (figs. 4, 5).

The ovicell does not entirely surround the aperture and is quite different from the ovicell of other species of the same genus.

*Affinities.*—This species is well characterized by the arborescent form of its zoarium. In its direct tremocyst and in the form of its aperture, it differs from species of the same genus.

It differs from *Cellaria schreibersi* Reuss, 1869, in which the zoarium is vincularian in its median avicularium and its bifurcated zoarium.

*Occurrence.*—Vicksburgian ("Chimney rock" of Marianna limestone): One mile north of Monroeville, Alabama (abundant).

Vicksburgian (Red Bluff clay): Seven and one-half miles southwest of Bladen Springs, Alabama (rare).

*Cotypes.*—Cat. No. 64271, U.S.N.M.

### SCHIZOMAVELLA LONGIROSTRIS, new species.

Plate 85, fig. 13.

*Description.*—The zoarium is free, bilamellar, very small; the two lamellae are easily separable. The zooecia are elongated, distinct, oval; the frontal is convex and formed of a tremocyst with large pores. The aperture is orbicular or transverse; the anter is large and semilunar; the rimule is wide and concave. The ovicell is globular and salient; its orifice is always closed by the operculum. The median avicularium is *long*, salient, provided with a pivot and a long triangular beak.

*Measurements.*—Aperture $\begin{cases} ha = 0.10 \text{ mm.} \\ la = 0.12 \text{ mm.} \end{cases}$ Zooecia $\begin{cases} Lz = 0.65\text{–}0.80 \text{ mm.} \\ lz = 0.40 \text{ mm.} \end{cases}$

*Affinities.*—We possess only a few small specimens of this species, and it has therefore been impossible for us to make a careful study of it. It appears to present some interesting peculiarities in its ovicell and in the disposition of its large avicularium; but it is necessary to await more material.

There is a similar recent species, *Schizoporella longirostrata* Hincks, 1882, but its avicularium is not median.

*Occurrence.*—Vicksburgian (Red Bluff clay): Red Bluff, Wayne County, Mississippi (rare).

*Holotype.*—Cat. No. 64264, U. S. N. M.

### SCHIZOLAVELLA,[1] new genus.

The ovicell is closed by the operculum. The operculum bears a variable rimule. The frontal is a tremocyst. There are two lateral avicularia.

*Genotype.*—*Schizoporella vulgaris* Moll, 1803.

*Range.*—Rupelian—Recent.

This genus differs from *Schizomavella* only in the lateral position of the avicularia and in the muscular attachments of the operculum, which are more distant from the border.

The functions of the avicularia seem to be multiple; but they are not well known. The generic divisions based on these organs always present a relative uncertainty which only further studies can eliminate.

The fossil species of this same genus are:

*Schizolavella* (*Eschara*) *phymatopora* Reuss, 1869.

*Schizolavella* (*Lepralia*) *schizostoma* MacGillivray, 1895.

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[1] *lav*=abbreviation of "lateral avicularia."

### Genus STYLOPOMA Levinsen, 1909.

1909. *Stylopoma* Levinsen, Morphological and Systematic Studies on the Cheilostomatous Bryozoa, pl. 18. (Name only.)

The ovicell is hyperstomial. It covers the apertura and the avicularia entirely. The frontal is a tremocyst. The apertura is provided with a small linear rimule.

*Genotype.—Stylopoma* (*Eschara*) *spongites* Pallas, 1766.

*Range.*—Miocene—Recent.

Levinsen proposed this name for *Eschara spongites* and *Schizoporella longirostris* Hincks, 1886; but having recognized that the size of the rimule is not a generic character, he suppressed it. We reestablish the genus, basing it upon the function of the passage of the eggs, which operates in a very different manner from that in *Schizopodrella*, where the species would otherwise have been placed. The great development of the ovicell above the apertura assures this function.

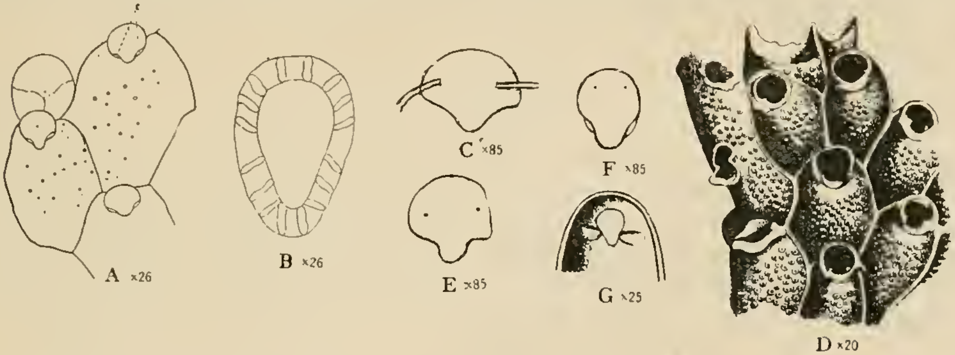

Fig. 108.—Genus *Dakaria* Jullien, 1904.

A–C. *Dakaria condylata* Nordgaard, 1906. A. Sketch of zooecia, × 26. B. Sketch showing dietellae, × 26. C. Operculum, × 85. (After Nordgaard, 1906.)

D. *Dakaria chevreuxi* Jullien, 1904. Young zooecia, × 20. (After Jullien, 1904.)

E. *Dakaria magniporata* Nordgaard, 1906. Operculum, × 85. (After Nordgaard, 1906.)

F, G. *Dakaria gelida* Waters, 1904. F. Operculum, × 85. G. Interior of zooecium showing the oral condyles, × 25. (After Waters, 1904.)

### Genus DAKARIA Jullien, 1903.

1903. *Dakaria* Jullien, Resultants des Campagnes scientifiques du Prince de Monaco, fasc. 23, Bryozoaires provenant des Campagnes de *l'Hirondelle* (1886–88), p. 90

The ovicell is hyperstomial and closed by the operculum. The frontal is a tremocyst. The operculum bears a wide rimule and articulates often on two condyles; its muscular attachments are elongated on the border. No avicularia.

*Genotype.—Dakaria chevreuxi* Jullien, 1903.

*Range.*—Lutetian-Recent.

The recent species of this genus are:

*Dakaria chevreuxi* Jullien, 1903.

*Dakaria* (*Schizoporella*) *condylata* Nordgaard, 1906.

*Dakaria magniporata* Nordgaard, 1906.

*Dakaria gelida* Waters, 1904.

The known fossil species are:

*Dakaria* (*Lepralia*) *squamoidea* Reuss, 1864.

*Dakaria* (*Cellaria*) *beyrichi* Stoliczka, 1862.

*Dakaria* (*Schizoporella*) *subsquammoidea* Koschinsky, 1885.

This genus differs from *Phonicosia* in a wider sinus of the apertura. Perhaps it may be necessary to introduce here all the Schizoporellae, having the same form of operculum, the same frontal, and provided with lateral avicularia, as long as the special function of the latter is not clearly defined.

All the species of this genus have not the special form of apertura mentioned by Jullien for *Dakaria chevreuxi*. But as this species must enter normally into the new genus we have adopted Jullien's name so as not to encumber the literature with a new term.

### DAKARIA BREVIS, new species.

Plate 46, fig. 19.

*Description.*—The zoarium is uni to multilamellar and incrusts shells or bryozoa. The zooecia are distinct, fusiform, *short;* the frontal is convex and almost smooth, ornamented with very small granules. The aperture is small, transverse; the rimule very wide and little distinct from the anter. The ovicell is salient, globular. elongated, of the same nature as the frontal. There is no median avicularium.

*Measurements.*—Aperture $\begin{cases} ha=0.05 \text{ mm.} \\ la=0.07 \text{ mm.} \end{cases}$ Zooecia $\begin{cases} Lz=0.50\text{–}0.60 \text{ mm.} \\ lz=0.25\text{–}0.35 \text{ mm.} \end{cases}$

*Affinities.*—The ovicelled zooecia are somewhat larger than the others; their operculum is also slightly larger. We have observed an ordinary calcified zooecium and an ovicelled zooecium presenting the same phenomenon. We had supposed before that these zooecia corresponded to the diseased polypides.

*Dakaria brevis* differs from *D. laxata* in its smaller zooecial dimensions ($Lz=0.50$ mm. instead of 0.80 mm.), in a smaller aperture, and in its elongated ovicell.

*Occurrence.*—Middle Jacksonian (Castle Hayne limestone): Wilmington, North Carolina (rare).

*Holotype.*—Cat. No. 64062, U.S.N.M.

### DAKARIA LAXATA. new species.

Plate 46, fig. 20.

*Description.*—The zoarium incrusts shells. The zooecia are distinct, elongated, *wide,* fusiform; the frontal is convex and finely granulated. The aperture is suborbicular; the rimule is very wide and scarcely distinct from the anter. The ovicell is globular, very salient; it is closed by the operculum, for it covers much of the aperture; its surface is granulated like the frontal. No median avicularium.

*Measurements.*—Aperture $\begin{cases} ha=0.12 \text{ mm.} \\ la=0.12 \text{ mm.} \end{cases}$ Zooecia $\begin{cases} Lz=0.20 \text{ mm.} \\ Lz=0.55\text{–}0.60 \text{ mm.} \end{cases}$

*Affinities.*—This species differs from *Schizomavella granulifera* and *Schizomavella elongata* in the absence of the median avicularium and in its incrusting zoarium.

It differs from *Dakaria brevis* in its much larger zooecial dimensions.

It is probable that the granulations hide very small tremopores.

*Occurrence.*—Upper Jacksonian (Ocala limestone): Old Factory, 1½ miles above Bainbridge, Georgia (rare).

*Holotype.*—Cat. No. 64063, U.S.N.M.

### Genus METROPERIELLA Canu and Bassler, 1917.

1917. *Metroperiella* CANU and BASSLER, Synopsis of American Early Tertiary Cheilostome Bryozoa, Bulletin 96, United States National Museum, p. 40.

The ovicell is hyperstomial and completely surrounds the aperture. The rimule is a large rounded sinus. The frontal is a tremocyst bearing a median avicularium.

*Genotype.*—*Metroperiella* (*Schizoporella*) *lepralioides* Calvet. 1903.

*Range.*—Jacksonian-Recent.

The known fossil species of the genus are:

*Metroperiella* (*Lepralia*) *trigonostoma* Reuss, 1847.

*Metroperiella* (*Schizoporella*) *lata* MacGillivray, 1882.

There are some avicularian zooecia with a large mandible in all the species of this genus.

### METROPERIELLA (?) ALBORA, new species.

Plate 47, figs. 1, 2.

*Description.*—The zoarium is unilamellar. The zooecia are elongated, distinct, nearly cylindrical; the frontal is a tremocyst with irregular pores, and is very little convex. The aperture is oval; the rimule is semielliptical, very wide and separated from the anter solely by two lateral denticles on which the transverse axis of the operculum is inserted; a wide, *white*, improminent peristome surrounds the aperture. The median avicularium is small, little salient. elliptical, the beak turned toward the bottom.

*Measurements.*—Aperture $\begin{cases} ha=0.15 \text{ mm.} \\ la=0.15 \text{ mm.} \end{cases}$ Zooecia $\begin{cases} Lz=0.75 \text{ mm.} \\ lz=0.35\text{–}0.40 \text{ mm.} \end{cases}$

*Affinities.*—The frontal tremocyst reposes on a very thin and finely perforated olocyst. The tremopores are very short tubules with their section visible on the olocyst. Around each aperture there are four large tremopores: two placed on the distal zooecia and each of the two others on adjacent zooecia.

This species differs from *Metroperiella grandipora* in its much narrower zooecia (0. 35 mm. instead of 0.45 mm.), its wide white peristome and the four large pores around the peristome.

We have not discovered the ovicell.

It differs from *Metroperiella porosa* in its larger aperture, less regular tremopores and much shorter median avicularium.

*Occurrence.*—Middle Jacksonian: Wilmington, North Carolina (rare); Baldock, Barnwell County, South Carolina (rare).

*Holotype.*—Cat. No. 64064, U.S.N.M.

### METROPERIELLA GRANDIPORA, new species.

Plate 47, figs. 3–6.

*Description.*—The zoarium creeps over algae; it is formed of many lamellae superposed on the same side. The zooecia are distinct, very little elongated, hexagonal; the frontal is convex; the tremocyst has wide-open pores surmounting a very thin, finely perforated olocyst. The ovicell is large, very prominent, completely surrounding the aperture. The aperture is large, oval, with a very wide rimule separated from the anter by two condyles. The median avicularium is salient, triangular, small and provided with very small lateral denticles.

*Measurements.*—Aperture $\left\{\begin{array}{l} la=0.15\text{–}0.16 \text{ mm.} \\ ha=0.15\text{–}0.16 \text{ mm.} \end{array}\right.$ Zooecia $\left\{\begin{array}{l} Lz=0.60\text{–}0.70 \text{ mm.} \\ lz=0.45\text{–}0.50 \text{ mm.} \end{array}\right.$

*Variations.*—There are some wide zooecia (fig. 4) and some long zooecia (fig. 6), sometimes both kinds may be adjacent (fig. 3).

Certain regular zooecia are transformed into interzooecial avicularia (fig. 6); the aperture is closed by a large spatulate mandible and articulates on two lower condyles.

On the normal zooecia the condyles, on which the operculum articulates, are visible in the interior by turning the specimen.

The ovicell has in front a large fragile area, which easily disappears in the process of fossilization (fig. 6).

*Affinities.*—This species differs from *Metroperiella acervata*, which is also pleurilamellar in a larger aperture ($la=0.15$ mm. instead of 0.12 mm.), the much smaller avicularium, its large tremopores and the absence of a salient thread around the zooecia.

It differs from *Metroperiella porosa* in its nonbilamellar zoarium, its median avicularium much smaller (0. 15 mm. instead of 0.35 mm.), and in its somewhat larger aperture ($la=0.15$ mm. instead of 0.12 mm.).

It differs from *Metroperiella albora* in its wide zooecia ($lz=0.45$ mm. and not 0.35 mm.), and in the absence of a wide peristome, which is white and nonsalient.

*Occurrence.*—Middle Jacksonian (Castle Hayne limestone): Wilmington, North Carolina (rare).

*Cotypes.*—Cat. No. 64065, U.S.N.M.

### METROPERIELLA POROSA, new species

Plate 47, figs. 7–11.

*Description.*—The zoarium is free, formed of two lamellae, which are irregular, back to back, and separable. The zooecia are distinct, elongated, hexagonal; the frontal is little convex and formed by a tremocyst with numerous wide open *pores*. The aperture is oval, with a wide, rounded rimule, separated from the anter by two condyles visible in the interior. The ovicell is large, globular, salient: it completely surrounds the aperture, forming around it a prominent peristomic: it is formed of a large frontal area surrounded by a salient collar. The median avicularium is long, very thin, remote from the aperture.

*Measurements.*—Aperture $\begin{cases} ha=0.12\text{–}0.14 \text{ mm.} \\ la=0.12\text{–}0.14 \text{ mm.} \end{cases}$ Zooecia $\begin{cases} Lz=0.60\text{–}0.70 \text{ mm} \\ lz=0.50 \text{ mm.} \end{cases}$

*Variations.*—The beak of the avicularium is very long, thin, and fragile; it is only visible on the best preserved specimens (fig. 11); on others it has the aspect of a small triangular pore (fig. 8), but always remote from the aperture and not salient.

The zooecia with a thick tremocyst are sometimes bordered by a small salient thread (fig. 8).

The frontal area of the ovicell is fragile; it often disappears in the process of fossilization.

The orifice of the ovicelled zooecia is quite variable. The operation of the operculum appears to be complex. It must be lowered much externally to permit the extrusion of the tentacles, which ought, moreover, to be very thin. The operculum never closes the ovicell because the outer orifice does not exactly correspond to its form, but in opening it offer a shelter sufficient for the passage of the eggs. It is probable also, as in many other Schizoporellae that it remains closed during the escape of the larvae.

In figure 8 the reader may note two zooecia which are transformed into interzooecial avicularia analogous to the zooecia of *Arthropoma cecilii* Savigny-Audouin, 1812–1826, figured in 1890 by Kirkpatrick and which we have reproduced on text figure 105.

We have observed (fig. 8) a calcified zooecium whose aperture is covered by the tremocyst.

The median avicularium is the result of the development of an inner bud, as it is easy to note on inner surfaces.

*Affinities.*—This species differs from *Metroperiella biplanata*, in which zoarium is also bilamellar, in its much larger instead of very minute tremopores.

It differs from *Metroperiella grandipora* in its smaller aperture ($la$=0.12 mm. instead of 0.15 mm), its median avicularium, which is very large and remote from the aperture, and its zoarium, which is bilamellar and not pleurilamellar.

*Occurrence.*—Middle Jacksonian: Near Lenuds Ferry, South Carolina (common); Wilmington, North Carolina (common); 3¼ miles south of Perry, Georgia (rare).

*Cotypes.*—Cat. No. 64066, U.S.N.M.

### **METROPERIELLA BIPLANATA** Canu and Bassler, 1917.

Plate 47, figs. 12–19.

1917. *Metroperiella biplanata* CANU and BASSLER, Synopsis of American Early Tertiary Cheilostome Bryozoa, Bulletin 96, United States National Museum, p. 41, pl. 4, fig. 4.

*Description.*—The zoarium is free, formed of *two flat* lamellae, back to back, and inseparable. The zooecia are much elongated, distinct, fusiform; the frontal is convex and formed of a tremocyst with numerous very fine pores. The aperture is oval, formed of a semilunar anter, and with a wide, rounded rimule, separated by two inner condyles. The ovicell is hyperstomial, large, globular, salient; it completely surrounds the aperture, forming about it a very pronounced peristomie, in which is placed its special orifice; the peristomie is very irregular. The median avicularium is small, little salient, in the immediate vicinity of the rimule.

*Measurements.*—Aperture $\left\{\begin{array}{l} ha=0.16\text{–}0.18\text{ mm.} \\ la=0.14\text{ mm.} \end{array}\right.$ Zooecia $\left\{\begin{array}{l} Lz=1.00\text{–}1.10\text{ mm.} \\ lz=0.50\text{–}0.60\text{ mm.} \end{array}\right.$

*Variations.*—As in the preceding species, the passage of the eggs into the ovicell is singularly aided by the development of the special peristomie, in which even the operculum itself is completely concealed when it opens. This operculum can not open without allowing the water to get into the compensation sac, and in consequence without extending its tentacles; it is therefore rather probable, especially if the larvae are large, that the operculum remains closed during their escape and that the ovicell is indeed closed by a special operculum, as in *Schizopodrella* (fig. 15).

We have observed some avicularian zooecia, as in *Metroperiella porosa* and *Metroperiella grandipora.*

There are some wide zooecia of 0.65 mm. (fig. 12) and some narrow ones of 0.40 mm (fig. 16). Very frequently the zooecia are margined (figs. 12, 16); we know that this arrangement has for its object the separation of the ectocyst of the zoarium for a purpose unknown for these rigid species.

Above many of the zooecia (fig. 16) can be observed a crescent-shaped cicatrix, the morphological significance of which is unknown to us.

The median avicularium disappears on the ovicelled zooecia.

The closed zooecia (fig. 15) are perhaps zooecia which have lost their polypide by accident.

*Affinities.*—This species differs from *Metroperiella porosa*, in which the zoarium is also bilamellar, in its tremocyst with numerous and very small pores, its small avicularium placed quite near the rimule and its larger zooecial dimensions.

It differs from *Metroperiella grandipora* in its bilamellar zoarium, its tremocyst with small pores and its long zooecia.

Of all the species of *Metroperiella* this is the only one in which the zooecial length may be 1 mm.

*Occurrence.*—Middle Jacksonian (Castle Hayne limestone): Wilmington, North Carolina (very common).

*Cotypes.*—Cat. No. 62590, U.S.N.M.

### METROPERIELLA ACERVATA, new species.

Plate 48, figs. 1–5.

*Description.*—The zoarium is formed of many lamellae *piled up* on one another, all on the same side; it probably creeps over algae. The zooecia are distinct, elongated, hexagonal, bordered by a regular, salient thread. The frontal is little convex, nearly flat, smooth. The aperture is small suborbicular provided with a vestibular arch, formed of a semilunar anter and of a wide, rounded rimule, separated by two internal condyles. The ovicell is globular, salient, completely surrounding the aperture to form around it a peristomie. The median avicularium is long, thin, much removed from the aperture.

*Measurements.*—Aperture $\begin{cases} ha=0.14 \text{ mm.} \\ la=0.12 \text{ mm.} \end{cases}$ Zooecia $\begin{cases} lz=0.56\text{–}0.65 \text{ mm.} \\ Lz=0.75 \text{ mm.} \end{cases}$

*Affinities.*—The characteristic of this species is its smooth and nonporous frontal; this is an exception in the genus.

It differs from *Metroperiella grandipora*, in which the zoarium is also multilamellar in its larger micrometric dimensions and its nonporous frontal.

It differs from *Metroperiella porosa*, in which the median avicularium is long and distant from the aperture, in its multilamellar zoarium, its smooth zooecia and its larger zooecial length (0.75 mm. instead of 0.65–0.70 mm).

*Occurrence.*—Middle Jacksonian: Wilmington, North Carolina (common); near Lenuds Ferry, South Carolina (rare); Eutaw Springs, South Carolina (rare).

*Cotypes.*—Cat. No. 64068, U.S.N.M.

### METROPERIELLA LATIPORA, new species.

Plate 47, fig. 20.

*Description.*—The zoarium is free and formed of two lamellae, back to back, and separable. The zooecia are distinct, polygonal, surrounded by a prominent thread; the frontal is flat, formed of a tremocyst with small pores. The apertura is *large*, transverse, elliptical, provided with a very wide rimule; it is larger and provided with an elevated peristome in the ovicelled zooecia. The ovicell is large, salient, globular, somewhat embedded in the distal zooecia, smooth, completely surrounding the apertura. The median avicularium is distant from the apertura, long, thin, triangular, very little salient, garnished with a pivot.

*Measurements.*—Aperture $\begin{cases} ha=0.14 \text{ mm.} \\ la=0.17 \text{ mm.} \end{cases}$ Zooecia $\begin{cases} Lz=0.72 \text{ mm.} \\ lz=0.30 \text{ mm.} \end{cases}$

*Affinities.*—This species much resembles the variations in *Metroperiella porosa*. It differs from *M. porosa* in its larger and transverse apertura ($la=0.17$ and not 0.14 mm.) and in its much wider and not triangular rimule.

*Occurrence.*—Middle Jacksonian: Rich Hill, Crawford County, Georgia (very rare); Eutaw Springs, South Carolina (very rare).

*Holotype.*—Cat. No. 64067, U.S.N.M.

### Genus EMBALLOTHECA Levinsen, 1909.

1909. *Emballotheca* LEVINSEN, Morphological and Systematic Studies on the Cheilostomatous Bryozoa, p. 333.

The ovicell is hyperstomial and opens above the aperture by a wide orifice which the operculum may close when it opens the aperture. The aperture bears a concave proximal border and a wide rounded rimule. The operculum has muscular attachments near the border; that of the ovicelled zooecia is larger. The frontal and the ovicell are covered by the same tremocyst with large pores surmounting a very finely perforated olocyst.

*Genotype.*—*Emballotheca* (*Eschara*) *quadrata* MacGillivray, 1880.

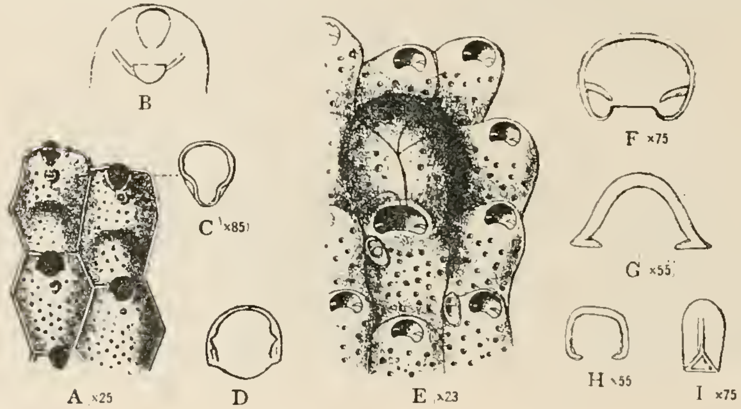

FIG. 109.—Genus *Emballotheca* Levinsen, 1909.

A–D. *Emballotheca subimmersa* MacGillivray, 1879. A. Zooecia, × 25. B. Decalcified cell, showing lateral tubular connections of the avicularian chamber. C. Operculum of ordinary zooecium, × 85. D. Operculum of ovicelligerous zooecium, × 85. (A–D after Waters, 1889.)

E–I. *Emballotheca quadrata* MacGillivray, 1880. E. Zooecia, × 23. Six different zooecia take part in the formation of the ovicell figured. F. Aperture of zooecium, × 75. G. Operculum of ovicelligerous zooecium, × 55. H. Operculum of ordinary zooecium, × 55. I. Avicularian mandible, × 75. (E–I after Levinsen, 1909.)

*Range.*—Jacksonian-Recent.

The known recent species of this genus are:

*Emballotheca* (*Schizoporella*) *furcata* Busk, 1884.

*Emballotheca* (*Eschara*) *quadrata* MacGillivray, 1880.

*Emballotheca* (*Lepralia*) *subimmersa* MacGillivray, 1879.

### EMBALLOTHECA LATICAPITATA, new species.

Plate 48, fig. 6.

*Description.*—The zoarium is free and bilamellar. The zooecia are large distinct, very little elongated, polygonal, enlarged distally; the frontal is convex, formed of a tremocyst closely united to the subjacent, finely perforated olocyst; the tremopores are wide and separated by small tuberosities. The aperture is large, elongated, with a very large, semicircular rimule, with two salient denticles serving as pivot. The ovicell is enormous, somewhat embedded in the distal zooecia, globular and salient. Two large, triangular avicularia are placed above the aperture; their beak is directed toward the medium axis of the zooecia; they have a strong calcareous pivot.

*Measurements.*—Aperture of ordinary zooecia $\begin{cases} ha=0.25 \text{ mm.} \\ la=0.20 \text{ mm.} \end{cases}$ Zooecia $\begin{cases} Lz=0.80 \text{ mm.} \\ lz=0.70 \text{ mm.} \end{cases}$

Aperture of ovicelled zooecia $\begin{cases} ha=0.32 \text{ mm.} \\ la=0.30 \text{ mm.} \end{cases}$

*Affinities.*—The distal part of the zooecia is often wider than the proximal part, which gives them the aspect of a *broad head.*

This species differs from the recent *Emballotheca quadrata* MacGillivray, 1880, in its smaller micrometric dimensions and the entire absence of a mucro concealing the rimule.

This is a magnificent species, of which only two specimens have been found.

*Occurrence.*—Middle Jacksonian (Castle Hayne limestone): Wilmington, North Carolina (rare).

*Holotype.*—Cat. No. 64069, U.S.N.M.

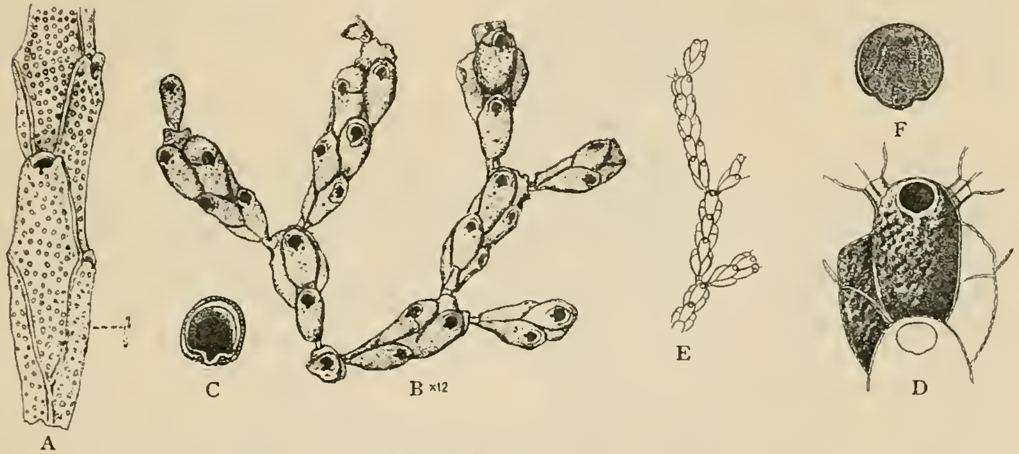

Fig. 110. Genus *Tetraplaria* Tenison-Woods, 1878.

A. *Tetraplaria australis* Tenison-Woods, 1878. Zooecia. (After MacGillivray 1895.)

B, C. *Tetraplaria* (*Pollaploecium*) *gilbertensis* Maplestone, 1909. Zoarium, × 12, and aperture. (After Maplestone, 1909.)

D–F. *Tetraplaria* (*Arborella*) *dichotoma* Osburn, 1914. D. Zooecia. E. Portion of colony, showing mode of growth. F. Operculum. (D–F after Osburn, 1914.)

### Genus TETRAPLARIA Tenison-Woods, 1878.

1878. *Tetraplaria* Tenison-Woods, On some Australian Tertiary fossil corals and Polyzoa, Journal and Proceedings of the Royal Society New South Wales, vol. 12, p. 61.—Synonyms *Pollaploecium* Maplestone, 1909, and *Arborella* Osburn, 1914.

The zoarium is articulated. The zooecia are arranged in pairs, back to back, facing four ways; the opposite pairs of two sides alternating at right angles with the other two.

*Genotype.*—*Tetraplaria australis* Tenison-Woods, 1878.

The known species of this genus are:

*Tetraplaria australis* Tenison-Woods, 1878. Fossil.

*Tetraplaria* (*Pollaploecium*) *gilbertensis* Maplestone, 1909. Recent.

*Tetraplaria* (*Arborella*) *dichotoma* Osburn, 1914. Recent, Florida.

*Tetraplaria* (*Cellaria*) *schreibersi* Reuss, 1869. Fossil.

This genus is purely zoarial. The articulation is only an adaptation to some special circumstances, particularly to life on large marine algae whose mobility is very great. It is therefore not astonishing to note some apertures of different form. On the other hand, the characters of adaptation can very well become fixed in general descent and transform themselves into essential characters One must not forget that the bryozoan individual is the zoarium issued directly from the larva, and not the zooecium, which is only a bud of the aforesaid larva.

In the present case our knowledge of the ovicells and the operculum is of little importance. It is better, therefore, to admit the genus such as Tenison-Woods has conceived it.

The genus still exists in the waters off the coast of Florida, which is still another proof in favor of the continuity of the faunas in the Gulf of Mexico.

### TETRAPLARIA TUBERCULATA, new species.

Plate 48, figs. 7–10.

*Description.*—The zoarium is articulated, the segments are composed of a dozen zooecia placed back to back, disposed in four series, placed two by two at right angles. The zooecia are little distinct, elongated, subcylindrical; the frontal is convex and formed of a tremocyst with small pores. The aperture is semilunar; the proximal border is somewhat concave and bears a triangular rimule. On each margin of the aperture there are two large symmetrical *tubercles.*

*Measurements.*—Zooecia $\left\{\begin{array}{l} Lz=0.12 \text{ mm.} \\ lz=0.11 \text{ mm.} \end{array}\right.$

*Affinities.*—In the distinctly schizoporelloid form of its aperture this species resembles very much *Tetraplaria australis* Tenison-Woods, 1878.[1] It differs in its nonoblique aperture and the presence of two oral tubercles.

*Occurrence.*—Upper Jacksonian (Ocala limestone): Chipola River, east of Marianna, Florida (rare).

*Cotypes.*—Cat. No. 64070, U.S.N.M.

### TETRAPLARIA CAUDIFERA, new species.

Plate 48, figs. 11–14

*Description.*—The zoarium is articulated; the segments are formed of four longitudinal rows of alternate zooecia, placed at right angles. The zooecia are distinct. very elongated, narrowed in the back in the form of a *tail;* the frontal is convex and formed of an incomplete tremocyst surrounding a sort of smooth plastron. The aperture is elongated, elliptical, bearing two small, lateral denticles; there is a small vestibular arch. On each side of the aperture there are two small, very simple avicularia without denticle or pivot.

*Measurements.*—Apertures $\left\{\begin{array}{l} ha=0.19 \text{ mm.} \\ la=0.13 \text{ mm.} \end{array}\right.$ Zooecia $\left\{\begin{array}{l} Lz=1.3\text{–}1.5 \text{ mm.} \\ lz=0.40 \text{ mm.} \end{array}\right.$

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[1] It is to be noted that the figure given by Tenison-Woods 1878, resembles but little the figure of MacGillivray, 1895. The first is smooth with a lepralioid aperture; the second is punctate with a schizoporelloid aperture.

*Affinities.*—The form of the aperture is rather indeterminate; it is impossible to say whether this species belongs to the Schizoporellae or to the Hippoporae.

It resembles for this reason *Cellaria schreibersi* Reuss, 1869, of the Priabonian, but differs from it in the form of its zooecia, which are very thin in the posterior, in their great length, and in its incomplete tremocyst.

It differs from *Tetraplaria tuberculata*, not only in the form of its orifice, but in the replacement of the two lateral tubercles by two small avicularia.

*Occurrence.*—Middle Jacksonian: Baldock, Barnwell County, South Carolina (rare).

*Cotypes.*—Cat. No. 64071, U.S.N.M.

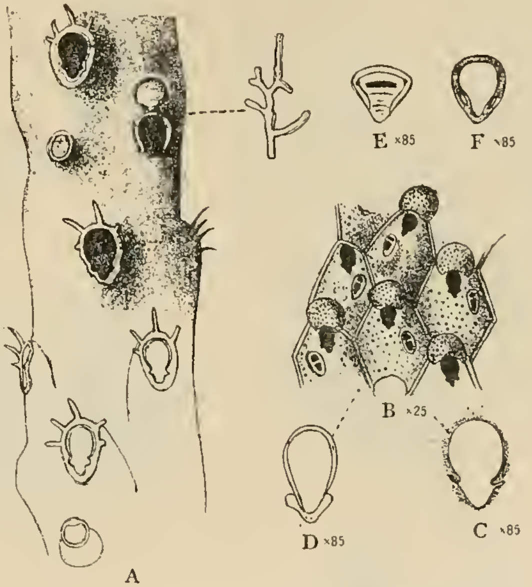


FIG. 111.—Genus *Gemellipora* Smitt, 1872.

A. *Gemellipora glabra* Smitt, 1872. Zoarium, natural size, and zooecia, enlarged. (After Smitt, 1872.)

B–D. *Gemellipora protusa* Thornely, 1905. B. Ovicelled zooecia, × 25. C. Interior of a zooecium, showing the oral aperture, × 85. D. Operculum, × 85. (B–D after Waters, 1913.)

E. *Gemellipora triangula* Hincks, 1881. Operculum, × 85. (After Waters, 1887.)

F. *Gemellipora arrogata* Waters, 1879. Operculum, × 85. (After Waters, 1904.)

### Genus **GEMELLIPORA** Smitt, 1872.

1872. *Gemellipora* SMITT, Floridan Bryozoa, pt. 1, Kongl. Svenska Vetenskaps-Akademiens Handlingar, vol. 10, No. 11, p. 35.

The opercula are subtriangular with two small lateral projections, corresponding with two small lateral teeth in the apertura; the muscular attachment is close to the side of the operculum. The apertura of the ovicelligerous zooecia differs in shape from that of the ordinary zooecia, in most species being wider with a flatter sinus. (After Waters, 1904.)

*Genotype.*—*Gemellipora glabra* Smitt, 1872.

*Range.*—Miocene-Recent.

This genus requires further examination.

The recent species are:

*Gemellipora* (*Schizoporella*) *triangula* Hincks, 1881.

*Gemellipora* (*Lepralia*) *arrogata* Waters, 1879.

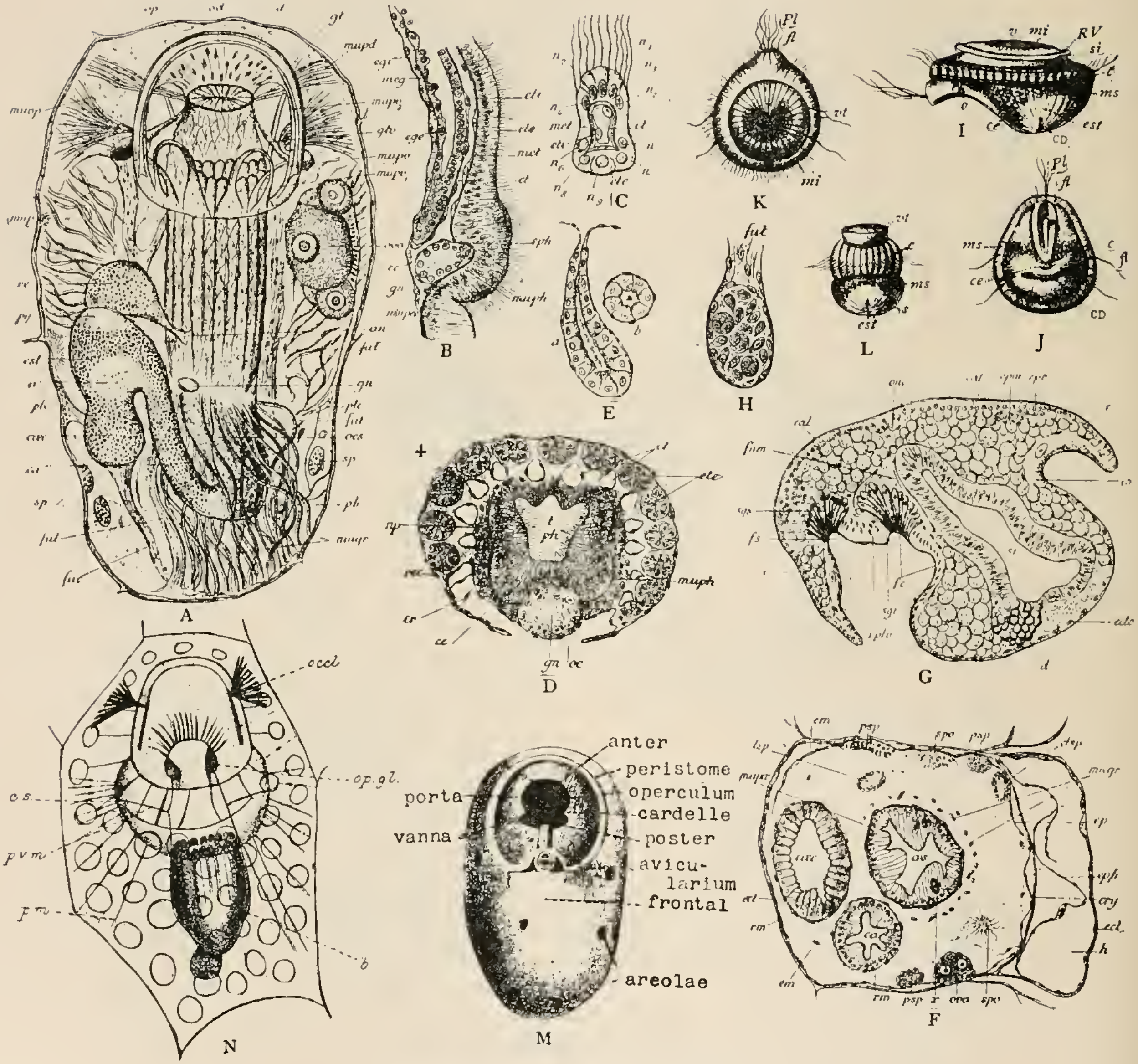
*Gemellipora* (*Schizoporella*) *lata* MacGillivray, 1882.

*Gemellipora glabra* Smitt, 1872.

*Gemellipora protusa* Thornely, 1905.

The fossil species are:

*Gemellipora elegantissima* MacGillivray, 1904.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c.s.
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pm
b
anter
peristome
operculum
cardelle
poster
avicularium
frontal
areolae
porta
vanna

FIG. 112.—Anatomy of the Hippoporae.

FIG. 112.—Anatomy of the Hippoporae.

A–L, N. *Hippodiplosia pallasiana* Moll, 1803. A. Sketch showing anatomy. B. Portion of a longitudinal section in the region of the pharynx. C. Transverse section of a tentacle. D. Transverse section of the lophophore passing through the orifice of the circular canal. E. Longitudinal and transverse sections of the vaginal glandular organ. F. Transverse section of a bryozooid. G. Median sagittal section of an embryo of this species. H. Tangential section of a multiporous septula. (A–H after Calvet, 1900.)

*an*, anus;
*ca*, cardiac region of the stomach;
*cal*, calotte (terminal bud);
*caec*, caecum;
*co*, corona;
*cry*, cryptocyst (skeleton);
*ct*, tentacular canal;
*d*, vaginal diaphragm;
*dsp*, deutospermatoblast morula;
*em*, mesenchyme elements;
*epm*, mesodermal thickening;
*epe*, ectodermal thickening;
*est*, stomach;
*ete*, external tentacular epithelium;
*ep*, epiderm of the hypostege;
*glv*, vaginal glands (=opercular glands of Waters and Harmer).
*muop*, opercular muscles;
*mup*, parietal muscles;
*mupd*, parietal-diaphragm muscles;
*muph*, peripharyngeal muscular fibers;
*mupoe*, periesophageal muscular fibers;
*mupo*, parieto-vaginal muscles;
*np*, peripharyngeal nerves;
*oc*, orifices of the circular canal;
*oes*, esophagus;
*ova*, ovary;
*pe*, septule;
*ph*, pharynx;
*plc*, communication plates;
*plv*, vibratile plume;
*pplv*, papilla of vibratile plume;
*psp*, protospermatoblast morulae;
*py*, pylorus;
*re*, rectum;
*rm*, mesenchyme covering of polypide;
*sgi*, inferior glandular system;
*sgs*, superior glandular system;
*si*, internal sac;
*sp*, spermatoblast morulae;
*spv*, ciliated tritospermatoblast morulae;
*tm*, mesenchyme;
*tr*, transverse muscular fibers of the circular canal

I–L. Lateral face, (I) oral face, (J) aboral face, (K) dorsal face, (L) of the larva. (After Barrois, 1877.)

*c*, corona;
*cc*, cavity between the two branches of the stomach;
*cd*, digestive cavity;
*est*, stomach;
*fl*, flagellum;
*ms*, oral (labial) mesoderm;
*mi*, aboral mesoderm;
*o*, ciliated cleft.
*PL*, ciliated plume;
*ph*, pharynx;
*RV*, border of the terminal bud;
*si*, separating furrow;
*s*, oral or vestibular face;
*rt*, terminal bud (=calotte of Calvet).

N. Young zooecium. The compensatrix (*c. s.*) is still small. The pores extend around the distal margin of the operculum. (After Harmer, 1902.)

*b* polypide bud;
*occl*, occlusor muscles of operculum;
*opgl*, opercular glands (=vaginal glands of Calvet);
*p. m.*, parietal muscles;
*pvm*, parieto-vaginal muscles;
*s. c.*, compensatrix.

M. *Lepralia botulus* Jullien, 1903. Sketch of zooecium, showing terminology.

*Gemellipora polita* MacGillivray, 1904.

*Gemellipora auriculata* Maplestone, 1901.

Under the name of *Gemellipora*, Smitt has described two sorts of apertures. The first species described belongs to the genus *Pasythea* Lamouroux, 1812. The orifice of *Gemellipora glabra* is the one which has been considered as typical. In 1904, Waters gave a list of species of this genus; but it will be necessary to redistribute them into the genera *Schizomavella* and *Trypostega*.

### GEMELLIPORELLA, new genus.

The ovicell is hyperstomial and deeply embedded in the distal zooecium. The operculum does not close the ovicell and operates in a locella. The form of the aperture is like a keyhole. The frontal is garnished with lateral areolar pores and with a granular pleurocyst.

*Genotype.—Gemelliporella vorax*, new species. Range: Miocene, Pliocene.

The genus *Gemellipora* Smitt, 1872, comprised species with both a tremocyst and a pleurocyst; we group the latter in this new genus. The type species will be described in a forthcoming volume.

### Genus NIMBA Jullien, 1903.

1903. *Nimba* Jullien, Bryozoaires provenant des campagnes de *l'Hirondelle*, Monaco, p. 93.

The frontal is smooth or granular. The orifice is semilunar, with a rimule on the poster which is almost entirely formed of two large cardelles, which the rimule separates; the anter is smooth; the peristome forms a sort of aureola around the orifice, and the globular ovicell occupies the anterior region of the aureola. The opening of the ovicell is always closed by the operculum, which must lower itself to give passage to the larvae. (Translation after Jullien.)

*Genotype.—Nimba praetexta* Jullien, 1903. Recent (Azores).

### Genus CHARACODOMA Maplestone, 1900.

1900. *Characodoma* Maplestone, Further descriptions of the Tertiary Polyzoa of Victoria, pt. 4, Proceedings Royal Society of Victoria, vol. 13 (n. s.), pt. 1, p. 7, pl. 2, fig. 17.

"Zoarium in elongated quadrate internodes. Zooecia uniserial on each face of the zoarium. Apertura ovate with a sharp denticle on each side pointing downward over the lower or distal triangular portion." (Maplestone.)

*Genotype.—Characodoma halli* Maplestone, 1900. Miocene of Australia.

### Group 2. HIPPOPORAE Canu and Bassler, 1917.

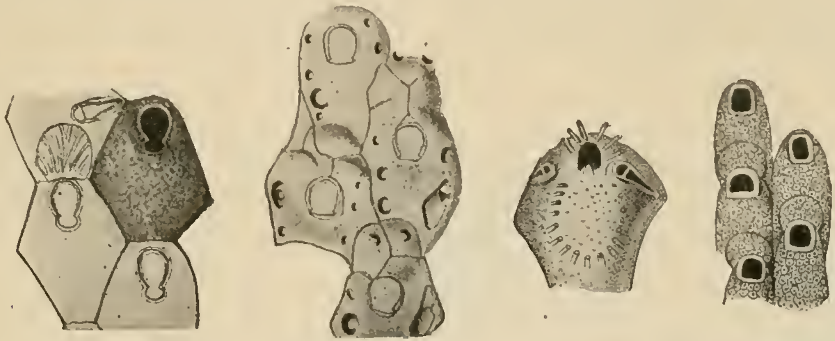
#### (LEPRALIIDAE Jullien, 1903.)

*Anatomical bibliography.*—1865. Smitt, Om Hafs-Bryozoernas utvekling och fett kroppar Ofversight, Kongl. Vetenskaps-Akademiens Forhändlingar, vol. 22, pp. 7, 28, pl. 1, figs. 11, 12; pl. 2, fig. 1, pl. 5, figs. 20–22.—1877. Barrios, Recherches sur l'embryologie des Bryozoaires, Travaux de l'Institut de Zoologie de Lille, fasc. 1, pl. 7, figs. 9, 13, 17, and 20.—1900. Calvet, Contribution a l'histoire naturelle des Bryozoaires ectoproctes marins, Montpellier, pl. 6.—1903. Harmer.

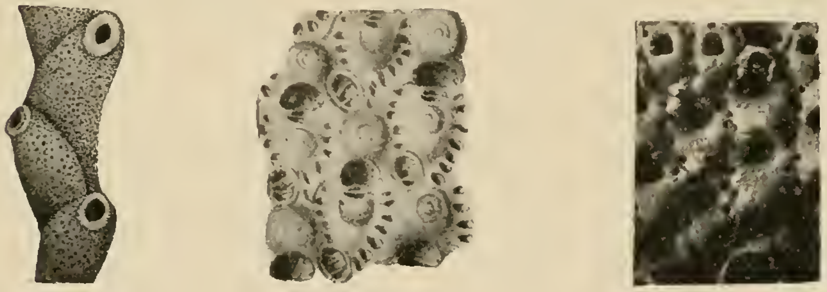
On the morphology of the Cheilostomata, Quarterly Journal of Microscopical Science, vol. 46, pl. 17.

The classification has been the object of study of Waters in 1898, 1909, and 1913.

The operculum has a projection on each side for muscular attachment; it is generally thick. The aperture bears two lateral denticles or cardelles serving as a pivot for the operculum. The ovicell is always hyperstomial.



A Hippoporina B. Hipponella C. Hippomenella D. Hippodiplosia



E. Hippozeugosella F. Hippadenella G. Hippoporella

FIG. 113.—Genera of the subfamily Hippoporae Canu and Bassler, 1917.

A. *Hippoporina porcellana* Busk, 1860. Recent.
B. *Hipponella hippopus* Smitt, 1867. Recent.
C. *Hippomenella mucronelliformis* Waters, 1898, × 25. Recent.
D. *Hippodiplosia pallasiana* Moll, 1803, × 20. Recent.
E. *Hippozeugosella arcuata*, new species, × 20. Lower Jacksonian, Jackson, Mississippi.
F. *Hippadenella margaritifera* Quoy and Gaymard, 1833, × 55. Recent.
G. *Hippoporella perforata*, new species. × 20, Vicksburgian of Alabama.

The distal part of the aperture is the anter; the proximal part is the poster. The cardelles separate the porta from the vanna. The porta serves for the passage of the tentacles. The vanna opens the compensation sac, which becomes filled during the extrusion of the polypide. We may suppose that the larger the vanna is the larger the compensation sac must be, and that consequently the polypide bears more tentacles and that they are larger.

### Genus HIPPOPORINA Neviani, 1895.

1895 *Hippoporina* Neviani, Bryozoi fossili della Farnesina Monte Mario presso Roma, Paleontologia Italica, p. 107.

The operculum is much contracted laterally. The cardelles are very large and always placed at the bottom of the aperture. The vanna is much smaller than the porta. The proximal border of the aperture is straight or somewhat concave. The ovicell is hyperstomial and closed by a special membrane without any connection with the operculum. The frontal is an olocyst.

*Genotype.*—*Hippoporina* (*Lepralia*) *porcellana* Busk, 1860.

*Range.*—Danian-Recent.

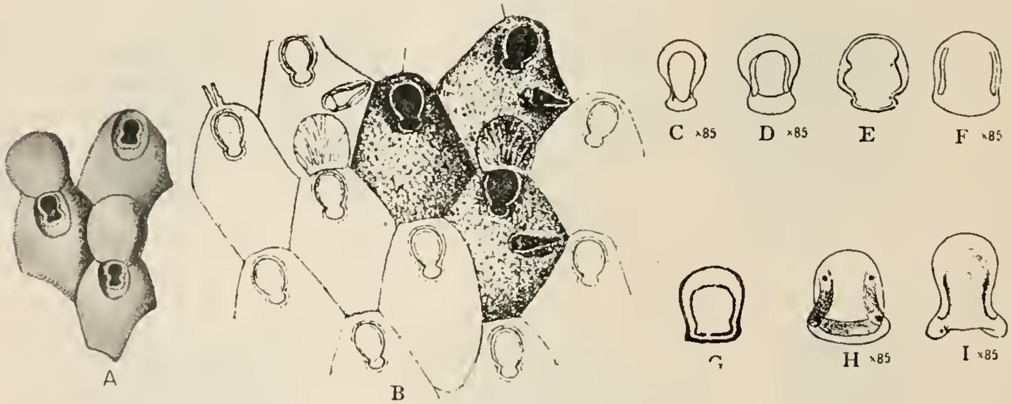


Fig. 114.—Genus *Hippoporina* Neviani, 1895.

A. *Hippoporina integra* Neviani, 1895. A. Ovicelled and ordinary zooecia, × 25. (After Neviani, 1900.)

B–E. *Hippoporina porcellana* Busk, 1860. B. Zooecia. (After Smitt, 1872.) C, D. Opercula of same colony, × 85. (After Waters, 1898.) E. Operculum. (After Norman, 1909.)

F, G. *Hippoporina collaris* Jullien, 1888. F. Operculum, × 85. (After Waters, 1900.) G. Operculum. (After Norman, 1909.)

H. *Hippoporina elimata* Waters, 1887. Operculum, × 85. (After Waters, 1885.)

I. *Flustra poissonii* Audouin, 1826. Operculum, × 85. (After Waters, 1887.) (Introduced by error.)

The recent species of this genus are:

*Hippoporina* (*Lepralia*) *porcellana* Busk, 1860.
*Hippoporina* (*Lepralia*) *collaris* Jullien, 1888.
*Hippoporina* (*Lepralia*) *elimata* Waters.

The fossil species are:

*Hippoporina integra* Neviani, 1900.
?*Hippoporina* (*Lepralia*) *sulcifera* Reuss, 1874.
?*Hippoporina* (*Eschara*) *conferta* Reuss, 1847.
?*Hippoporina* (*Eschara*) *delicata* Manzoni, 1877.
*Hippoporina parvula* Canu, 1909.
*Hippoporina hexagonalis* Canu, 1916.

*Historical.*—The genus *Lepralia* was created in 1838 by Johnston for all the incrusting species in which the frontal was calcified. This conception was followed by the paleontologists until 1880, when, the zoarial classification having been recognized as poor, Hincks applied the name *Lepralia* to only those species having cardelles. At the time that he resurrected this old name he should have followed the rules of nomenclature, but he did not do so, for under his discussion of *Lepralia* he did not include a single one of the species originally placed there by Johnston. Norman in 1905 suggested that the name *Lepralia* could be employed only for the species of which *Lepralia* (*Membraniporella*) *nitida* Johnston is the type.[1]

The first species placed under *Lepralia* by Johnston was *L. hyalina* (Linnaeus) which belongs to the earlier described genus *Hippothoa* Lamarck. *Lepralia nitida*, the second species, was therefore selected by Norman as the genotype, but unfortunately this same form had been selected by Smitt as the genotype of *Membraniporella* in 1873.

The paleontologists were much disturbed by the change in meaning attributed to the name *Lepralia*, for the number of fossil species published by Reuss, Busk, Manzoni, and others was considerable. Moreover, in 1895, Neviani changed the name of *Lepralia* to *Hippoporina*, employing it in the meaning given by Hincks. Canu, as a paleontologist, adopted *Hippoporina* immediately. Waters thought that it might be employed with restriction. In reality Neviani's genus was not yet precisely established. Of the three primitive species which he introduced, *Eschara foliacea* Solander, 1786, is of contested generic position, *Lepralia pallasiana* Moll. 1803, does not correspond exactly with the definition, and *Lepralia adpressa* Busk, 1854, has endozooecial ovicells. It is impossible to characterize a genus by the examination of a single function (hydrostatic in this case). Fortunately he established in 1900 the true characters of the genus *Hippoporina* by the publication of a superb figure of *Hippoporina integra*. A fossil species should not be taken as a genotype if a recent equivalent species can be found. All the species of the first group of Waters correspond to it exactly, and in this group *Lepralia porcellana* may be chosen as type of the genus *Hippoporina*.

In 1898 Waters thought that the genus *Lepralia* Hincks, 1880, might be separated according to the form of the operculum. His first group was provided with an operculum much contracted laterally. As mentioned before, it became the genus *Hippoporina*. The second group was provided with an operculum with straight or nearly straight borders. It is not a natural group, and two of the species which Waters included have been chosen as genotypes by ourselves.

### HIPPOPORINA MIDWAYANICA, new species.

Plate 7, figs. 17–19.

*Description.*—The zoarium incrusts other bryozoa. The zooecia are small, distinct, ovoid; the frontal is convex and smooth. The aperture bears a circular anter separated by two large cardelles from a convex rather large poster; it is surrounded by an incomplete peristome bearing 6 large spines. The ovicell is prominent, globular, smooth; it opens above the aperture. The avicularian zooecia are provided with a long, thin beak rounded at the extremity.

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[1] But this is not an obligation as he claims it is; rules are not laws. See Norman, 1905, Annals and Magazine Natural History, ser. 7, vol. 12, p. 99.

*Measurements.*—Aperture $\begin{cases} ha=0.10 \text{ mm.} \\ la=0.07 \text{ mm.} \end{cases}$ Zooecia $\begin{cases} Lz=0.40 \text{ mm.} \\ lz=0.25\text{–}0.30 \text{ mm.} \end{cases}$

*Affinities.*—The avicularian zooecia are very interesting; the beak develops around the aperture which does not preserve its form. The extensor muscle of the mandible passes by a sort of very narrow rimule (fig. 19) or by a wider one (fig. 18).

Such transformations exist in the Celleporidae. Waters noted very similar avicularian zooecia in *Holoporella pigmentaria* Waters, 1909.[1]

Another interesting peculiarity is the complete absence of dorsal olocyst, easy to see on the broken zooecia of figure 19. This economy of calcification is rather frequent on the incrusting species. This new species differs from *Hippoporina lucens* and *Hippoporina porcellana* Busk, 1860 (=*Lepralia cleidostoma* Smitt, 1872), in the presence of avicularian zooecia and the absence of frontal avicularia.

*Cotypes.*—Cat. No. 63824, U.S.N.M.

*Occurrence.*—Midwayan (Clayton limestone): One mile west of Fort Gaines. Georgia (rare).

### HIPPOPORINA LUCENS, new species.

Plate 48, figs. 15–17.

*Description.*—The zoarium incrusts shells. The zooecia are small, distinct, ovoid; the frontal is smooth, convex, *polished.* The aperture is elongated; the almost circular anter is separated by two large cardelles from a poster rather wide and straight. The ovicell is globular, salient, smooth; it is hyperstomial and opens above the aperture by an arched crescent shaped slit. The avicularium is very salient; its mandible is nearly perpendicular to the zooecial plane; it has a calcareous pivot.

*Measurements.*—Aperture $\begin{cases} ha=0.10\text{–}0.12 \text{ mm.} \\ la=0.09\text{–}0.10 \text{ mm.} \end{cases}$ Zooecia $\begin{cases} Lz=0.36\text{–}0.40 \text{ mm.} \\ lz=0.20\text{–}0.24 \text{ mm.} \end{cases}$

*Variations.*—The avicularium is very inconstant; it does not exist on all zooecia; its rupture causes the formation of an irregular cavity (fig. 15). The ovicell is formed of two calcareous lamellae perfectly distinct when broken (fig. 17). The frontal also becomes covered with a more or less granulated calcareous deposit (figs. 15, 16) of the origin of which we are ignorant.

*Affinities.*—This species is very close to *Hippoporina cleidostoma* Smitt, 1872 (=*H. porcellana* Busk, 1860), which is still living in the regions of Madeira and Florida. It differs from it in the position and form of its avicularium and the much smaller width of its aperture (0.09–0.10 mm. instead of 0.10–0.13 mm. mentioned by Smitt). This biologic persistence through the ages proves the constancy of the oceanic areas in the Tertiary period. Moreover, the recent species having been discovered fossil in the European Miocene proves that the great equatorial current already existed around the Sargasso Sea.

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[1] Reports on the Marine Biology of the Sudanese Red Sea, XII, Journal Linnean Society, vol. 31, p. 163, pl. 17, fig. 22.

This species differs from *Hippoporina biporosa* in a single ventral avicularium (instead of two oral avicularia), and in a longer aperture (*ha*=0.10 mm. instead of 0.08 mm.).

*Occurrence.*—Upper Jacksonian (Ocala limestone): West bank Sepulga River; Escambia County, Alabama (rare); Alachua, Florida (very rare); Bainbridge, Georgia (very rare).

Vicksburgian (Byram marl): Byram, Mississippi (rare).

Vicksburgian ("Chimney rock" of Marianna limestone): One mile north of Monroeville, Alabama (rare).

*Cotypes.*—Cat. Nos. 64073, 64074, U.S.N.M.

### HIPPOPORINA BIPOROSA, new species.

Plate 49, figs. 1–3.

*Description.*—The zoarium incrusts bryozoa. The zooecia are small, distinct, ovoid; the frontal is convex and smooth. The aperture is small and elongated; the anter nearly circular, is separated by two large cardelles from a poster wide and straight. The ovicell is globular and salient; it is hyperstomial and opens above the aperture. There are one or two small, lateral avicularia placed on the side of the aperture.

*Measurements.*—Aperture $\begin{cases} ha=0.10 \text{ mm.} \\ la=0.07 \text{ mm.} \end{cases}$ Zooecia $\begin{cases} Lz=0.40 \text{ mm.} \\ lz=0.28\text{–}0.30 \text{ mm.} \end{cases}$

*Affinities.*—This species differs from *Hippoporina lucens* and *Hippoporina cleidostoma* in the position of its small oral avicularia disposed on each side of the aperture.

*Occurrence.*—Middle Jacksonian (Castle Hayne limestone): Wilmington, North Carolina.

*Cotypes.*—Cat. No. 64076, U.S.N.M.

### HIPPOPORELLA, new genus.

The operculum is much contracted laterally. The cardelles are large. The vanna is much smaller than the porta. The proximal border of the apertura is somewhat concave. The ovicell is hyperstomial and never closed by the operculum. The frontal is bordered by areolar pores.

*Genotype.*—*Hippoporella perforata*, new species.

*Range.*—Jacksonian-Recent.

The presence of the areolar pores and of an almost smooth pleurocyst differentiates this genus from *Hippoporina* Neviani, 1895. The pleurocyst of the ovicell is formed of 3 pieces which are often visible on the fossils.

### HIPPOPORELLA MULTILAMELLOSA. new species.

Plate 48, figs. 18–22.

*Description.*—The zoarium is free and formed of many lamellae superposed on the same side; the base in contact with the subjacent algae presents some hexagonal zooecia striated transversely and sometimes perforated. The zooecia are distinct, hexagonal, separated by a very salient thread; the frontal is smooth, convex, ornamented with some lateral areolae. The aperture is elongated; the anter is almost circular and separated by two very salient cardelles from a poster rectilinear exteriorly and concave interiorly. The ovicell is large, globular, salient, imbedded in the distal zooecia; it opens above the aperture and can not be closed by the operculum. The avicularium is large, transverse, without pivot; it is placed on the frontal irregularly.

*Measurements.*—Aperture (exterior) $\left\{\begin{array}{l} ha=0.13 \text{ mm.} \\ la=0.10\text{–}0.11 \text{ mm.} \end{array}\right.$ Zooecia $\left\{\begin{array}{l} Lz=0.50 \text{ mm.} \\ lz=0.35\text{–}0.40 \text{ mm.} \end{array}\right.$

*Variations.*—In the interior (fig. 21) the two cardelles are represented by two transverse condyles, somewhat salient. The avicularium is most characterized by its mandible lodged in a calcified area, spatulate in form and of little depth; the orifices which serve as passage for the retractor and extensor muscles of the mandible are separated or joined together. The frontal is a compact olocyst perforated simply by some lateral areolae.

*Affinities.*—In its exterior aspect and its multilamellar zoarium, this species may be confounded with *Dakaria brevis.* It differs from the latter in its aperture, of which the anter is rectilinear, in its hexagonal and much larger zooecia and in its ovicell imbedded in the distal zooecia.

It differs from *Hippoporella perforata* in its smaller micrometric measurements and in its inferior face, where all the zooecia are not regularly perforated.

*Occurrence.*—Middle Jacksonian (Castle Hayne limestone): Wilmington, North Carolina (common).

*Cotypes.*—Cat. No. 64075, U.S.N.M.

### HIPPOPORELLA PERFORATA, new species.

Plate 86, figs. 7–13.

*Description.*—The zoarium creeps on algae forming orbicular lamellae, free and irregular. The zooecia are hexagonal, very little elongated, distinct, separated by a furrow; the frontal is smooth and convex; it is an olocyst perforated laterally by some large areolae. The aperture is semilunar, transverse; two deep cardelles separate a large anter from a small rectilinear poster. The ovicell is very large, imbedded in the distal zooecium and is hyperstomial. It opens above the aperture by a large opening without connection with the operculum. On the lower face of the zoarium the zooecia are convex, hexagonal, perforated in front of the aperture by a round pore, and striated transversely. The ancestrula is membraniporoid.

*Measurements.*—Aperture $\begin{cases} ha=0.06 \text{ mm.} \\ la=0.08 \text{ mm.} \end{cases}$ Zooecia $\begin{cases} Lz=0.48\text{–}0.50 \text{ mm.} \\ lz=0.35 \text{ mm. (lower face)} \\ \quad\ 0.40 \text{ mm. (upper face)} \end{cases}$

*Variations.*—The exterior surface of a zoarium creeping on the roots of algae is naturally larger than the surface in immediate contact with the substratum. When the calcification is intense and the walls thick, the micrometric difference for each zooecium becomes perceptible, as we have established in this species. The number of lateral areolae is about six; they are frequently above the aperture; their place is inconstant, in no wise regular. The orbicular zoarium contains at the center some zooecia somewhat different; they are erect and ornamented with a large auriculated vibraculum; they arise from the exaggerated development of one of the areolae (fig. 11). The perforations of the lower face of the zoarium serve probably as a passage for radical fibers; they are often surrounded by hollow, hydrostatic tuberosities (fig. 13). The tangential section (fig. 10) shows that the olocystal elements of the frontal wall are grouped in lines radiating from the aperture toward the areolae; perhaps a very compact pleurocyst covers the olocyst.

*Hippomenella radicata* and *Schizoporella geminopora* Reuss, 1847, have also some radicular pores on their lower face, but they belong to different genera easy to differentiate.

This species differs from *Hippoporella multilamellosa* in its unilamellar and orbicular zoarium, in the absence of a separating salient thread, in the constant presence of the pores, and in its transverse aperture.

*Occurrence.*—Vicksburgian (Glendon member of Marianna limestone): West bank of Conecuh River, Escambia County, Alabama (common).

*Cotypes.*—Cat. No. 64272, U.S.N.M.

### HIPPOPONELLA, new genus.

The operculum is contracted laterally. The ovicell is hyperstomial and always closed by the operculum. The frontal is bordered with areolar pores.

*Genotype.—Hippoponella* (*Lepralia*) *hippopus* Smitt, 1867. Recent.

### Genus HIPPOMENELLA Canu and Bassler, 1917.

1917. *Hippomenella* Canu and Bassler, Synopsis of American Eary Tertiary Cheilostome Bryozoa, Bulletin 96, United States National Museum, p. 41.

The aperture bears two small cardelles placed very low and separating a large porta from a small vanna; it is always semielliptical (in the interior). The ovicell, hyperstomial, is deeply imbedded in the distal zooecia; it opens by a large opening above the aperture, but it is never closed by the operculum. The frontal is formed of an olocyst perforated laterally by some areolae and supporting a pleurocyst more or less developed. The ovicell bears laterally two areas in the form of a lunar crescent and more or less perforated. There are nearly always some spines and some avicularia.

*Genotype.—Hippomenella* (*Lepralia*) *mucronelliformis* Waters, 1899.

*Range.*—Lutetian-Recent.

The species belonging to this genus are:

*Hippomenella* (*Mucronella*) *perforata* Maplestone, 1902. Recent, Australia.
?*Hippomenella* (*Lepralia*) *peristomata* Waters, 1899. Recent, Madeira.
*Hippomenella* (*Lepralia*) *mucronelliformis* Waters, 1899. Recent. Madeira.

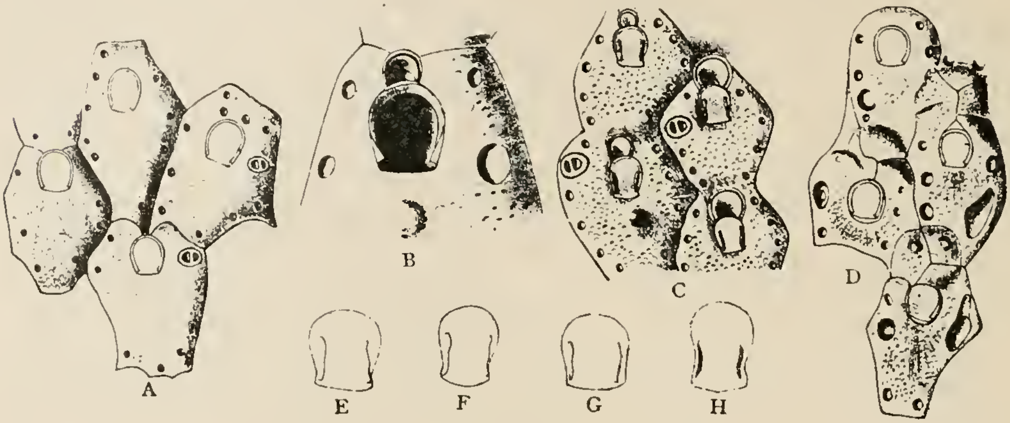

FIG. 115.—Genus *Hippoponella*, new genus.

*Hippoponella hippopus* Smitt, 1867. A. Ordinary zooecia, magnified. B. Upper part of a zooecium, showing the aperture and two triangular hinge teeth. C. Zooecia with ovate avicularia. D. Zooecia and zooecia with sutural lines. E–H. Opercula. (A–G after Levinsen, 1916; H after Waters.)

*Hippomenella* (*Petralia*) *convexa* Canu, 1913. Lutetian.
*Hippomenella* (*Petralia*) *mucronata* Canu. 1913. Lutetian.
*Hippomenella* (*Lepralia*) *semilevis* Reuss, 1869. Priabonian.

This genus, of which we describe 15 new species, is a very natural one; the examination of our plates reveals no aberrant type. Unfortunately, on account of an extraordinary polymorphism, the determinations are exceedingly difficult, and the classification of these species has given us great trouble.

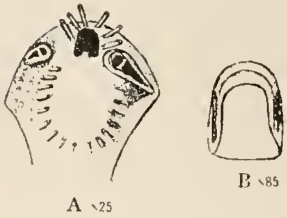

FIG. 116.—Genus *Hippomenella* Canu and Bassler, 1917.

A, B. *Hippomenella mucronelliformis* Waters, 1898. A. Zooecium with its avicularia and areolae, × 25. B. Operculum, × 85. (A, B after Waters, 1898.)

A singular anomaly is the disappearance of the genus in the recent waters off Florida, where no species has been cited by Smitt in 1872, or by Osburn in 1914. In Europe the genus made its first appearance in the Lutetian in the vicinity of Bordeaux; it occurs fossil in the Priabonian, and it still exists at Madeira. It is correct to say that it is extremely rare, for only the type of Waters species exists in the Funchal Museum.

This genus is intermediate between *Hippoporina* Neviani, 1895. and *Peristomella* Levinsen, 1902; it contains some species which in their exterior aspect have exactly the appearance of species of the latter genus, but they are provided with cardelles.

This is truly an American genus and it furnishes us with many important stratigraphic data, as noted in the table below:

*Geological distribution, species of Hippomenella.*

| | Lower Jacksonian. | Middle Jacksonian. | Upper Jacksonian. | Vicksburgian. |
|---|---|---|---|---|
| *Hippomenella rotula*, new species | +. | ......... | ......... | ......... |
| *Hippomenella transversata*, new species | ......... | + | ......... | ......... |
| *Hippomenella angustaedes*, new species | ......... | + | ......... | ......... |
| *Hippomenelle incondita*, new species | + | + | ......... | ......... |
| *Hippomenella capitimortis*, new species | ......... | ......... | ......... | + |
| *Hippomenella costulata*, new species | ......... | ......... | ......... | + |
| *Hippomenella alifera*, new species | + | + | + | ......... |
| *Hippomenella radicata*, new species | + | + | + | ......... |
| *Hippomenella transversora*, new species | ......... | ......... | ......... | + |
| *Hippomenella pungens*, new species | ......... | ......... | ......... | + |
| *Hippomenella punctata*, new species | + | + | ......... | ......... |
| *Hippomenella ligulata*, new species | ......... | + | ......... | ......... |
| *Hippomenella tuberosa*, new species | ......... | + | ......... | ......... |
| *Hippomenella axiculata*, new species | ......... | + | ......... | ......... |
| *Hippomenella crassicollis*, new species | ......... | ......... | + | + |

Thus the lower Jacksonian is characterized by *Hippomenella rotula* alone; the middle Jacksonian by *Hippomenella transversata*, *H. angustaedes*, *H. ligulata*, *H. axiculata*, and *H. tuberosa;* the upper Jacksonian by no species. The Vicksburgian is characterized by *H. capitimortis*, *H. costulata*, *H. transversora* and *H. pungens*. *H. radicata*, and *H. alifera* range through the entire Jacksonian.

### Group 1. ZOARIUM BILAMELLAR.

### HIPPOMENELLA ROTULA, new species.

Plate 49, figs. 4–14.

*Description.*—The zoarium is free, formed by two lamellae, back to back, and inseparable. The fronds are flat or undulating and may measure 2 centimeters in length. The zooecia are distinct, very elongated, fusiform; the frontal, little convex and smooth, is garnished laterally with a double row of areolae much crowded. The aperture is elliptical (in the interior); it presents exteriorly a mucronoid convexity very salient on its proximal border; there are two very small cardelles. The ovicell is large, globular, salient, much imbedded in the distal zooecia; the two lateral areas bear three of four large cavities separated by *radial* projections. The avicularia are small, inconstant, placed laterally below the aperture, provided with a pivot, and with a triangular beak directed toward the base. No spines.

*Measurements.*—Aperture (interior) $\begin{cases} ha=0.17 \text{ mm.} \\ la=0.15 \text{ mm.} \end{cases}$ Zooecia $\begin{cases} Lz=0.60\text{–}1.00 \text{ mm.} \\ lz=0.40\text{–}0.50 \text{ mm.} \end{cases}$

*Variations.*—The micrometric variations are extraordinary; they vary from one to two times. There are sometimes narrow zooecia (fig. 5), again there are wide zooecia (fig. 6), and often giant zooecia (fig. 7). The avicularia are absent (fig. 5) or present (figs. 7–9), generally small. The mucronoid convexity is prominent (fig. 5) or absent (fig. 7). The cavities and the pores of the ovicell are variable in size and in position (figs. 7, 8).

In the interior (fig. 10) the olocyst is in juxtaposition with a tremocyst with tubular pores; the areolae are therefore of the same nature as the tremopores. The olocyst in the upper part of the frontal is covered with a pleurocyst in which the elements are oriented toward the mucro according to rule (fig. 11).

Figure 4 represents a monstrosity in which an abnormal bud has caused the formation of inverted zooecia; these monstrosities may moreover be perfectly oriented but superposed upon other zooecia. This kind of gemmation, which is here only a monstrosity, is, on the contrary, the rule in the Celleporidae.

*Affinities.*—This species differs from *Hippomenella angustaedes* in its aperture, which is not elliptical exteriorly, in its zoarium of large spreading fronds, and in the absence of oral spines.

It differs from *Hippomenella incondita* in the pores of its ovicell, which are larger, less numerous, and more regularly disposed.

It differs from *Hippomenella capitimortis* in its ovicell with many pores (instead of two diaphragmed pores).

It differs from *Hippomenella costulata* in the absence of fine costules on the ovicell and in its much smaller avicularia.

It differs from all the other *Hippomenellae* save *H. transversata* in its broad bilamellar zoarium. In the latter species the avicularia are oriented transversally.

*Occurrence.*—Lower Jacksonian (Moodys marl): Jackson, Mississippi (very common).

*Cotypes.*—Cat. No. 64077, U.S.N.M.

### HIPPOMENELLA TRANSVERSATA, new species.

Plate 49. figs. 15–17.

*Description.*—The zoarium is bilamellar. The zooecia are elongated, distinct, elliptical; the frontal is little convex and garnished laterally by a double or triple row of triangular areolae separated by very short costules. The apertura is somewhat elongated, elliptical; two very small cardelles separate a large anter from a somewhat smaller poster. The avicularia are placed symmetrically on each side of the apertura; they are small, triangular and oriented almost *transversally*.

*Measurements.*—Apertura $\left\{\begin{array}{l} ha=0.18\text{ mm.}\\ la=0.16\text{ mm.}\end{array}\right.$ Zooecia $\left\{\begin{array}{l} Lz=0.80\text{–}1\text{ mm.}\\ lz=0.60\text{ mm.}\end{array}\right.$

*Affinities.*—Unfortunately we have no knowledge of the ovicell of this species, but the peculiar disposition of the avicularia is absolutely characteristic and almost unique in the genus.

The species differs from *Hippomenella transversora*, in which avicularia are in the same place, in the triangular form of the avicularia and in the absence of the large oral mucro.

*Occurrence.*—Middle Jacksonian (Castle Hayne limestone): Wilmington, North Carolina (rare).

*Cotypes.*—Cat. No. 64078, U.S.N.M.

### HIPPOMENELLA ANGUSTAEDES, new species.

Plate 49, figs. 18, 19.

*Description.*—The zoarium is free and formed of two lamellae, back to back, and inseparable; the fronds are of *little width*, flabellate, and do not contain more than six longitudinal rows of zooecia. The zooecia are elongated, distinct, oval; the frontal is convex, smooth, and garnished with a double lateral row of areolae, numerous and small. The aperture is elliptical, elongated, divided into equal parts by two cardelles; the peristome very little salient, bears 4 to 6 large distal spines. The avicularia are placed laterally in the vicinity of and below the aperture; they have a pivot and their triangular beak is directed downward; they are never equal in size.

*Measurements.*—Aperture $\left\{\begin{array}{l} ha=0.16 \text{ mm.} \\ la=0.12 \text{ mm.} \end{array}\right.$ Zooecia $\left\{\begin{array}{l} Lz=0.70\text{–}0.80 \text{ mm.} \\ lz=0.46 \text{ mm.} \end{array}\right.$

*Affinities.*—This species differs from *Hippomenella transversata* in its smaller micrometric measurements ($Lz<0.80$ mm.) and in its lower placed avicularia, which are larger and more oblique.

It differs from *Hippomenella incondita* in its much smaller avicularia and its orifice exteriorly elliptical and not semilunar.

It differs from *Hippomenella capitimortis* in the size of its avicularia and in its aperture exteriorly elliptical (and not semilunar).

It differs from *Hippomenella costulata* in its avicularia placed lower and with a beak turned downward (and not laterally) and in the presence of oral spines.

It differs from *Hippomenella rotula* in its narrow fronds and its elliptical aperture garnished with spines.

*Occurrence.*—Middle Jacksonian (Castle Hayne limestone): Wilmington, North Carolina (rare).

*Holotype.*—Cat. No. 64079, U.S.N.M.

### HIPPOMENELLA INCONDITA, new species.

Plate 50, figs 1–8.

*Description.*—The zoarium is free, formed of two lamellae, back to back, and inseparable; the fronds are wide, irregular, and undulated. The zooecia are distinct, somewhat elongated, elliptical, swollen; the frontal is convex and garnished laterally with a double row of large areolae. The aperture is exteriorly semilunar; the proximal border has a very convex mucronoid protuberance. The ovicell is hyperstomial, salient, globular, much imbedded in the distal zooecia, never closed by the operculum, very *irregularly* punctate. The avicularia are placed laterally on the line of the areolae, close to and somewhat below the aperture; they are small, little prominent, and their beak is directed downward. No spines.

*Measurements.*—Aperture (exterior) $\left\{\begin{array}{l} ha=0.13 \text{ mm.} \\ la=0.15 \text{ mm.} \end{array}\right.$ Zooecia $\left\{\begin{array}{l} Lz=0.75\text{–}0.90 \text{ mm.} \\ lz=0.24\text{–}0.25 \text{ mm.} \end{array}\right.$

*Variations.*—The zooecia are long (fig. 2) or short (fig. 3). The punctations of the ovicell are very irregular (figs. 5–7) and rarely (fig. 6) it is possible to see two lateral primitive areas. The lateral avicularia are rarely wanting (fig. 2): we have observed (fig. 4) an inexplicable case of an avicularian monstrosity. The zooecia apparently never have spines; however, our figure 3 presents some traces of them.

*Affinities.*—This species differs from *Hippomenella angustaedes* and from *Hippomenella transversata* in its aperture exteriorly semilunar (and not elliptical) with mucronoid convexity.

It differs from *Hippomenella rotula*, from *Hippomenella capitimortis*, and from *Hippomenella costulata* in the extremely irregular punctations of its ovicell.

It differs from all other *Hippomenellae* in its bilamellar zoarium.

*Occurrence.*—Middle Jacksonian: Rich Hill, 5¼ miles south of Knoxville, Georgia (very common); 3¼ miles south of Perry, Georgia (common); 18 miles west of Wrightsville, Georgia (rare); 17 miles northeast of Hawkinsville, Georgia (common); 3½ miles north of Grovania, Georgia (common); Twiggs County, Georgia (several localities); 12 miles southeast of Marshallville, Georgia (common); near Lenuds Ferry, South Carolina (rare); Baldock, Barnwell County, South Carolina (rare); Eutaw Springs, South Carolina (common).

Jacksonian (Zeuglodon bed): Suck Creek, Clarke County, Mississippi (rare); Shubuta, Mississippi (very rare).

*Cotypes.*—Cat. Nos. 64080–64082, U.S.N.M.

### HIPPOMENELLA CAPITIMORTIS, new species.

Plate 85, figs. 17, 18.

*Description.*—The zoarium is free, lamellar, formed of two lamellae, back to back, and inseparable. The zooecia are large, elongated, elliptical, or oval; the frontal is convex, smooth, garnished laterally with a double row of numerous areolae. The orbicular aperture (in the interior) is exteriorly formed of a semilunar anter and of a very convex and mucronoid poster. The ovicell is hyperstomial, embedded in the distal zooecia; the two lateral areas are perforated by a very large pore in part occupied by a denticle shaped like the head of a lance. The avicularia are absent or very small.

*Measurements.*—Aperture (exterior) $\begin{cases} ha=0.20 \text{ mm.} \\ la=0.15\text{–}0.18 \text{ mm.} \end{cases}$ Zooecia $\begin{cases} Lz=0.70\text{–}0.90 \text{ mm.} \\ lz=0.45\text{–}0.55 \text{ mm.} \end{cases}$

*Variations.*—The rows of areolae are often three in number; on certain parts of the zooecia they have thus the aspect of tremopores. The small avicularia develop in the place of an areola; they are placed at a distance from the aperture; they have a pivot and there is only one to each zooecium. The ovicell is very characteristic; it gives the zooecium the vague aspect of a *death's head*. We are absolutely ignorant of the physiologic use of the large perforations and of the little tongue in the form of a head of a lance which they contain.

*Affinities.*—This species much resembles *Hippomenella semilevis* Reuss, 1869, of the Priabonian. It differs from it in the presence of the little tongue in the pores of the ovicell, in its convex anter and in the absence of the large vibraculum which according to Waters develops at the side of the aperture in the European species.

The ovicell of this species is very characteristic, but unfortunately it is very rare; in its absence the determination offers some difficulties. It resembles considerably *Hippomenella rotula*, but differs in the larger aperture ($ha$=0.20 mm. instead of 0.15 mm. exteriorly) and in the small avicularium placed much lower.

*Occurrence.*—Vicksburgian (Marianna limestone): West bank of Conecuh River, Escambia County, Alabama (common); Salt Mountain, 5 miles south of Jackson, Alabama (common); Murder Creek, east of Castlebury, Conecuh County, Alabama (common); near Claiborne, Monroe County, Alabama (common); deep well, Escambia County, Alabama.

*Cotypes.*—Cat. Nos. 64267, 64268, U.S.N.M.

### HIPPOMENELLA COSTULATA, new species.

Plate 86, figs. 14–19.

*Description.*—The zoarium is free, more or less cylindrical, most often composed of six longitudinal rows of zooecia. The zooecia are elongated, distinct, oval. separated by a furrow; the frontal is very convex, finely granulated, surrounded by a single line of small triangular areolae, separated by some short, interareolar costules. The aperture is little elongated and suborbicular in the interior; on the exterior it shows a proximal lip more or less convex and salient; the peristome bears 4 to 6 spines. The ovicell is hyperstomial, much imbedded in the distal zooecia, garnished with two perforated areas with a large pore and *radial costules.* The avicularia placed on each side of the aperture are disposed obliquely or transversally; they are prominent, subtriangular, and are provided with a pivot.

*Measurements.*—Aperture (exterior) $\left\{\begin{array}{l} ha=0.15 \text{ mm.} \\ la=0.15 \text{ mm.} \end{array}\right.$ Zooecia $\left\{\begin{array}{l} Lz=0.65\text{–}0.75 \text{ mm.} \\ lz=0.40\text{–}0.45 \text{ mm.} \end{array}\right.$

*Variations.*—The two large pores of the ovicell are often divided into two parts by a small tongue or by an internal crossbar (fig. 17); the costules are sometimes altered (figs. 18, 19). The proximal lip of the aperture becomes sometimes a veritable mucro (fig. 19). The interareolar costules are attenuated (figs. 15, 16) or very complete (fig. 18). The avicularia are constant and symmetrical. The zoarium may have more than six rows of zooecia (fig. 19) and even be incrusting.

*Affinities.*—In its ovicell this species approaches *Hippomenella capitimortis;* it differs from it in the presence of the costules on the ovicell, the greater length of the avicularia and their lateral place on the side of the aperture, and the presence of a single row of areolae (instead of two).

It differs from *Hippomenella rotula* in its nonlamelliform zoarium, its somewhat larger oral dimensions, the finer costules of its ovicell, and the presence of spines.

It differs from *Hippomenella angustaedes* in its transversal or very oblique avicularia (and not almost longitudinal), in their symmetry and a single row of areolae.

*Occurrence.*—Vicksburgian ("Chimney rock" of Marianna limestone): One mile north of Monroeville, Alabama (very common).

Vicksburgian (Red Bluff clay): Seven and one-half miles southwest from Bladen Springs, Alabama (common).

*Cotypes.*—Cat. No. 64273, U.S.N.M.

### Group 2. ZOARIUM UNILAMELLAR (Semieschara).

### HIPPOMENELLA ALIFERA, new species.

Plate 50, figs. 9–18.

*Description.*—The zoarium is unilamellar and creeps over algae. On the inner face in contact with the substratum the zooecia are convex, hexagonal, formed of an olocyst covered by a pleurocyst and often ornamented by hydrostatic tuberosities. The zooecia are elongated, distinct, hexagonal or oval; the frontal is convex, smooth, surrounded by two or three rows of small and numerous areolae. The aperture is elliptical, elongated; the peristome very little salient, bears six large spines; two small cardelles separate a large anter from a smaller poster. The ovicell very large, very prominent, globular, and smooth, is hyperstomial and little embedded in the distal zooecia; a small median nerve separates the two areas. The avicularia are very large and salient; they are placed below and close to the aperture; their beak is triangular and directed obliquely toward the bottom; they have a calcareous pivot.

*Measurements.*—Aperture $\left\{\begin{array}{l} ha=0.18\text{–}0.20\text{ mm.} \\ la=0.14\text{–}0.16\text{ mm.} \end{array}\right.$ Zooecia $\left\{\begin{array}{l} Lz=0.70\text{–}0.80\text{ mm.} \\ lz=0.40\text{–}0.60\text{ mm.} \end{array}\right.$

*Variations.*—This species represents the height of polymorphism; there is not a single specimen comparable with another and not a single zooecium resembles its neighbor.

The areolae are often disposed in two or three rows (figs. 10, 13), sometimes spreading over all the frontal (fig. 11) and becoming true tremopores. The avicularia may be short and unsymmetrically disposed (fig. 10), but are generally very large and very salient, like extended *wings* (figs. 11, 14). The ovicells, globular (fig. 13) or pyriform (fig. 11), are almost always smooth.

The lower face of the zoarium is smooth (fig. 15); each dorsal is formed of two separable calcareous layers (fig. 16), a pleurocyst on an integral olocyst; the hydrostatic tuberosities are rare but may become very large (fig. 17). The zoarium may be incrusting.

In the interior the apertura shows a porta larger than the vanna, separated by two cardelles (fig. 8).

*Affinities.*—Its smooth ovicells and large avicularia characterize this species rather well. It differs from *Hippomenella radicata* in its larger aperture, its smooth ovicell, it avicularia symmetrically disposed, and in its dorsal not regularly perforated.

It differs from *Hippomenella transversata* in its elongated aperture (and not transverse), in its more salient avicularia and more than two rows of lateral areolae.

*Occurrence.*—Middle Jacksonian: Wilmington, North Carolina (very common); 3¼ miles south of Perry, Georgia (rare); 3½ miles north of Grovania, Georgia (very rare).

Upper Jacksonian (Ocala limestone): Alachua, Florida (rare); West bank of Sepulga River, Escambia County, Alabama (rare).

Jacksonian (Zeuglodon zone): Shubuta, Mississippi (rare).

*Cotypes.*—Cat. No. 64083, U.S.N.M.

### HIPPOMENELLA RADICATA, new species.

Plate 50, figs. 19–24.

*Description.*—The zoarium is unilamellar and creeps over algae; the lower face presents some elongated zooecia, smooth or striated transversally and regularly perforated by a *radicular* (?) pore. The zooecia are elongated, distinct, oval, separated by a furrow; the frontal is smooth, convex, garnished laterally by a double row of triangular areolae often separated by short pleurocystal costules. The aperture is elongated, elliptical, provided with two very small cardelles; it is surrounded by a peristome little salient, garnished with 6 large spines; there is a vestibular arch. The ovicell is globular, salient, hyperstomial, embedded in the distal zooecia, never closed by the operculum; the two areas are smooth or punctate. The avicularia are placed below the aperture; they are salient, triangular, the beak pointed toward the bottom, rarely symmetrical.

*Measurements.*—Aperture $\left\{\begin{array}{l} ha=0.16 \text{ mm.} \\ la=0.14 \text{ mm.} \end{array}\right.$ Zooecia $\left\{\begin{array}{l} Lz=0.70 \text{ mm.} \\ lz=0.36\text{–}0.40 \text{ mm.} \end{array}\right.$

*Variations.*—The areas of the ovicell are not always visible and are replaced by punctations (fig. 20). Of the two avicularia there is one almost always larger than the other; nevertheless symmetry is possible (fig. 22). The dorsal perforation is placed just below the aperture; it corresponds perhaps to some radicells as in the genus *Petralia* MacGillivray, 1881, it is rather constant; nevertheless we have some specimens which are deprived of it. The interareolar costules are absent or accentuated (fig. 21).

*Schizoporella geminipora* Reuss, 1867, and *Hippoporina perforata* are also provided with pores on the under side as in the genus *Petralia* MacGillivray, 1881. But the nature of their ovicell, never closed by the operculum, does not permit their arrangement in this genus.

*Affinities.*—This species differs from *Hippomenella alifera* in its less prominent and nonsymmetrically placed avicularia, in its larger interareolar costules, its smaller micrometric dimensions, and in its dorsal radicular pores.

It differs from *Hippomenella transversora* in its elongated aperture (and not transverse) and in the absence of a labial convexity at the aperture.

It differs from *Hippomenella punctata* in which the ovicell is porous in its smaller micrometric dimensions (=0.70 mm. and not 1.00 mm.) and in its free and nonincrusting zoarium.

*Occurrence.*—Lower Jacksonian (Moodys marl): Jackson, Mississippi (common).

Middle Jacksonian (Castle Hayne limestone): Wilmington, North Carolina (common).

Upper Jacksonian (Ocala limestone): Alachua, Florida (very rare).

*Cotypes.*—Cat. Nos. 64084, 64085, U.S.N.M.

### HIPPOMENELLA TRANSVERSORA, new species.

Plate 86, figs. 20–24.

*Description.*—The zoarium is unilamellar and creeps over algae or incrusts Orbitoides. The zooecia are elongated, distinct, ovoid; the frontal is convex, surrounded by a double row of triangular areolae separated by short costules. The aperture is *transverse* exteriorly; the peristome is complete and bears six distal spines and a salient, proximal mucro. The ovicell is globular, prominent, hyperstomial, embedded in the distal zooecia, never closed by the operculum; the two lateral areas are small and each is perforated with a large pore. The avicularia are small, transverse, triangular, placed below the aperture on the line of areolae. The ancestrula is a small zooecium. Three large lateral septules.

*Measurements.*—Aperture $\left\{\begin{array}{l} ha=0.12 \text{ mm.} \\ la=0.14\text{–}0.16 \text{ mm.} \end{array}\right.$ Zooecia $\left\{\begin{array}{l} Lz=0.80\text{–}0.90 \text{ mm.} \\ lz=0.40\text{–}0.44 \text{ mm.} \end{array}\right.$

*Affinities.*—This species differs from *Hippomenella alifera* and *Hippomenella radicata* in its transverse aperture and in the presence of an oral mucro. Its greater affinities are with *Hippomenella costulata*, from which it differs in its transverse aperture, its much-developed mucro, the more constant presence of the spines, and in its lamellar zoarium.

*Occurrence.*—Vicksburgian (Marianna limestone): West bank of Conecuh River, Escambia County, Alabama (rare); 1 mile north of Monroeville, Alabama (very rare); Murder Creek, east of Castlebury, Conecuh County, Alabama (very rare).

*Cotypes.*—Cat. Nos. 64274, 64275, U.S.N.M.

### HIPPOMENELLA PUNGENS, new species.

Plate 87, figs. 1–4.

*Description.*—The zoarium is free, unilamellar, creeping over algae. The zooecia are regular, hexagonal, very little elongated, separated by a furrow. The frontal is finely granulated, convex, surrounded by a double row of numerous very small areolae. The aperture is in the form of a horseshoe and is provided very inferiorly with two small cardelles; the anter is very large and the poster is small and slightly concave; the peristome is thin and bears four small distal spines. The ovicell is hyperstomial, globular, salient, embedded in the distal zooecia; it bears superiorly some costules more or less prominent and inferiorly two areas perforated by a large pore. The avicularia are small, triangular, symmetrically disposed below the aperture. On the lower face, the zooecia are smooth, convex and ornamented with numerous small hydrostatic *prickles.*

*Measurements.*—Aperture $\begin{cases} ha=0.23\text{ mm.} \\ la=0.17\text{ mm.} \end{cases}$ Zooecia $\begin{cases} Lz=0.75\text{–}0.85\text{ mm.} \\ lz=0.65\text{–}0.80\text{ mm.} \end{cases}$

*Affinities.*—This is the species which has the most resemblance to the type of the genus *Hippomenella mucronelliformis* Waters, 1899. from Madeira as much in its frontal as in the form of its aperture. It differs from it in its much larger aperture ($ha=0.23$ and not 0.16 mm.), in its avicularia of the same size, in the absence of a small oral mucro, and in its hydrostatic prickles.

It differs clearly from the other species of *Hippomenella* in the hexagonal form of the zooecia.

The frontal is formed of a very thin pleurocyst (fig. 4), very distinct from the subjacent olocyst, from which it may be separated.

*Occurrence.*—Vicksburgian ("Chimney rock" of Marianna limestone): One mile north of Monroeville, Alabama (very common).

*Cotypes.*—Cat. No. 64278, U.S.N.M.

### Group 3. ZOARIUM INCRUSTING.

### HIPPOMENELLA PUNCTATA, new species.

Plate 51, figs. 1–3.

*Description.*—The zoarium incrusts shells and bryozoa, especially the Cellepores. The zooecia are distinct, very elongated, fusiform, separated by a furrow; the frontal is convex, smooth in the middle, surrounded by a double row of small areolae and formed of an olocyst surmounted by a distinct pleurocyst. The aperture is elliptical, elongated, provided with two small cardelles placed very low; the peristome is thin and garnished with six distal spines. The ovicell is globular, salient, little imbedded in the distal zooecia, never closed by the operculum; the lateral areas almost disappear under a tremocyst, which has numerous small pores in quincunx. The avicularium is small, salient, triangular, placed eccentrically before the aperture; it is provided with a pivot and its beak is pointed downward.

*Measurements.*—Aperture $\begin{cases} ha=0.18\text{–}0.20\text{ mm.} \\ la=0.14\text{–}0.15\text{ mm.} \end{cases}$ Zooecia $\begin{cases} Lz=0.80\text{–}0.90\text{ mm.} \\ lz=0.35\text{–}0.45\text{ mm.} \end{cases}$

*Affinities.*—It is easy to understand in this species the deposit of the pleurocyst, the elements of which begin to be deposited around the areolae. The buds of the internal endocyst of which the areolae are the traces, reunite by coalescence to form a superior endocyst and continue therefore to be able to secrete and deposit the pleurocyst.

This species differs from *Hippomenella rotula* in the presence of its spines, its ovicell with small pores and not with large costules, and its zoarium incrusting and not bilamellar.

It differs from *Hippomenella radicata* in its larger dimensions, its ovicell with pores more numerous and smaller, its unique avicularia and its zoarium incrusting and not unilamellar.

It differs from the other incrusting species in the entire absence of oral mucro.

*Occurrence.*—Lower Jacksonian (Moodys marl): Jackson, Mississippi (common).

Middle Jacksonian: Eighteen miles west of Wrightsville, Georgia (very rare); Rich Hill, 5¼ miles southeast of Knoxville, Georgia (rare); one-half mile southeast of Georgia Kaolin Co. Mine, Twiggs County, Georgia (rare).

*Cotypes.*—Cat. No. 64086, U.S.N.M.

### HIPPOMENELLA LIGULATA, new species.

Plate 51, figs. 6–9.

*Description.*—The zoarium incrusts bryozoa, Orbitoides, or creeps over algae. The zooecia are short, distinct, oval; the frontal is very convex, smooth, surrounded by a double row of very small triangular areolae separated by some small interareolar costules. The aperture is somewhat elongated, semielliptical; a mucro *strap shaped*, very salient, oblique or erect, hides the aperture more or less; the peristome is ornamented with six large distal spines. The ovicell is globular, salient, imbedded in the distal zooecia, elongated, with two very large lateral areas. The two avicularia are placed below the aperture, they are of the same size and very projecting.

*Measurements.*—Aperture (exterior) $\begin{cases} ha=0.14 \text{ mm.} \\ la=0.14 \text{ mm.} \end{cases}$ Zooecia $\begin{cases} Lz=0.60\text{–}0.70 \text{ mm.} \\ lz=0.40\text{–}0.44 \text{ mm.} \end{cases}$

*Variations.*—Most of the time the zoarium is incrusting, but free zoaria are not rare; the lower face is smooth and, according to circumstances, garnished by the hydrostatic apophyses (fig. 7). When the mucro is erect the aperture is quite visible and without the peristomial thickening the species may be confounded with *Hippomenella alifera* (fig. 6). When it is oblique it hides the aperture more or less (fig. 8). In fossilization the small areolae are easily filled up and disappear (figs. 6, 8, which are the most habitual aspects); but superb specimens with areolae are not rare (fig. 9). Then they are triangular and the frontal is covered by very fine interareolar costules coalescent at the mucro.

Figure 9 perhaps represents a variety, for the two avicularia are much smaller and adjacent to the aperture.

*Affinities.*—This species differs from *Hippomenella alifera* in the salient mucro which ornaments its aperture and which in perspective completes the large peristome.

It is again in this same mucro that it differs from *Hippomenella radicata* and in the absence of perforated base.

It differs from *Hippomenella tuberosa* in its smaller micrometric dimensions ($Lz=0.70$ and not 0.84 mm.) and in its nontuberose frontal.

*Occurrence.*—Middle Jacksonian: Wilmington, North Carolina (common); near Lenuds Ferry, South Carolina (common); Eutaw Springs, South Carolina (rare).

*Cotypes.*—Cat. Nos. 64088, 64089, U.S.N.M.

### HIPPOMENELLA TUBEROSA, new species.

Plate 51, figs. 4, 5.

*Description.*—The zoarium incrusts bryozoa. The zooecia are large, elongated, elliptical, or hexagonal, separated by a deep furrow; the frontal is very convex, surrounded by a double row of areolae and decorated with *tuberosities* grouped in lines radiating from the mucro. The aperture is semielliptical in the interior with two cardelles placed very low; on the exterior it is surrounded distally by a peristome garnished with six large spines and proximally by a salient mucro. The ovicell is large, elongated, salient, hyperstomial, little imbedded in the distal zooecia, never closed by the operculum; the two areas are garnished laterally with an arched slit. The two avicularia are of equal dimensions; they are small, little salient, triangular, provided with a pivot, placed at some distance below the aperture; their beak is pointed downward and toward a neighboring aperture.

*Measurements.*—Aperture $\begin{cases} ha=0.14\text{–}0.16 \text{ mm.} \\ la=0.14 \text{ mm.} \end{cases}$ Zooecia $\begin{cases} Lz=0.84 \text{ mm.} \\ lz=0.70 \text{ mm.} \end{cases}$

*Affinities.*—This is a splendid species. The frontal tuberosities are of pleurocystal origin and the olocyst is easily visible below.

The species differs from *Hippomenella ligulata*, which shows some radial granulations, in its larger micrometric dimensions ($Lz=0.84$ and not 0.70 mm.) and in its much less salient avicularia.

*Occurrence.*—Middle Jacksonian (Castle Hayne limestone): Wilmington, North Carolina (very rare).

*Holotype.*—Cat. No. 64087, U.S.N.M.

### HIPPOMENELLA AXICULATA, new species.

Plate 51, figs. 10–13.

*Description.*—The zoarium incrusts bryozoa. The zooecia are distinct, wide, irregular in position; the frontal is little convex, smooth, surrounded by three lines of small and triangular areolae. The aperture is semielliptical with two cardelles, placed quite low; the peristome supports six to eight distal spines; an enormous, salient mucro, oblique or erect, lobate, hides the aperture more or less. The ovicell is large, salient, imbedded in the distal zooecium, is hyperstomial and is never closed by the operculum; it frontal area is perforated with an arched slit. The avicularia placed near the aperture are small and irregular.

*Measurements.*—Aperture $\begin{cases} ha=0.16 \text{ mm.} \\ la=0.14 \text{ mm.} \end{cases}$ Zooecia $\begin{cases} Lz=0.68\text{–}0.70 \text{ mm.} \\ lz=0.50 \text{ mm.} \end{cases}$

*Variations.*—The mucro forms in front of the aperture a small *pallet*, quite variable in form and dimensions. We are ignorant of the physiologic use of this organ, but it appears essential and analogous to that of the spines. If it be true that their existence is for the purpose of capturing the diatoms, our species must have been excessively voracious. What is strange is the absolute irregularity of the mucro; no one of them has any resemblance to the other and they are of all dimensions.

*Affinities.*—The zooecia with a small mucro resemble *Hippomenella ligulata*, but the present species differs in its wider zooecia ($lz=0.50$ and not 0.44 mm.), in the presence of three rows of areolae and in the occurrence of a single avicularium.

*Occurrence.*—Middle Jacksonian: Wilmington, North Carolina (rare); Eutaw Springs, South Carolina (rare).

*Cotypes.*—Cat. No. 64090, U.S.N.M.

### HIPPOMENELLA CRASSICOLLIS, new species.

Plate 51, figs. 14–19.

*Description.*—The zoarium incrusts bryozoa or shells. The zooecia are little distinct, elongated; the frontal is convex, surrounded with a double row of areolae, covered by a very thick and finely granulated pleurocyst. The aperture is semi-elliptical in the interior, with two cardelles placed very low; on the exterior it is surrounded with a peristome, salient, very *thick*, supporting two to six large distal spines. The ovicell is globular, salient, hyperstomial, embedded in the distal zooecia and ornamented with large radial costules. On the frontal there are two or three small triangular avicularia with pivots.

*Measurements.*—Aperture $\left\{\begin{array}{l} ha=0.18 \text{ mm.} \\ la=0.12 \text{ mm.} \end{array}\right.$ Zooecia $\left\{\begin{array}{l} Lz=0.60 \text{ mm.} \\ lz=0.50 \text{ mm.} \end{array}\right.$

*Variations.*—The variable aspect of this species depends on the active intensity of the pleurocystal calcification, which may be found shown in figures 16–19. The small avicularia are irregularly placed (fig. 19); nevertheless they may be symmetrical (fig. 16); they are elongated in proportion to the deposition of the pleurocyst with the result that they are always salient. The large costules of the ovicell are placed above the two lateral areas, sometimes perforated.

*Occurrence.*—Upper Jacksonian (Ocala limestone): Alachua, Florida (rare).

Vicksburgian (Byram marl): One-fourth mile west of Woodward, Wayne County, Mississippi (very rare).

Vicksburgian (Marianna limestone): Near Claiborne, Monroe County, Alabama (rare).

*Cotypes.*—Cat. Nos. 64091–64093, U.S.N.M.

KEY TO SPECIES OF HIPPOMENELLA.

| | | |
|---|---|---|
| 1. | Zoarium bilamellar | 2. |
| | Zoarium unilamellar | 5. |
| | Zoarium incrusting | 10. |
| 2. | Orifice elliptical, spines | 3. |
| | Orifice nonelliptical exteriorly, few or no spines | 4. |
| 3. | Very small, transverse, lateral avicularia | *H. transversata.* |
| | Beak of the large avicularia turned toward the bottom | *H. angustaedes.* |
| 4. | Ovicell with two large pores with a small tongue | *H. capitimortis.* |
| | Ovicell with large ribs and large pores | *H. rotula.* |
| | Ovicell with small, irregular pores | *H. incondita.* |
| | Ovicell with radial costules and two large pores | *H. costulata.* |

| | | |
|---|---|---|
| 5. | Exterior aperture transverse and mucronate | 6. |
| | Aperture elliptical | 7. |
| 6. | Two small lateral avicularia | *H. transversora.* |
| | Two large avicularia below the aperture | *H. ligulata.* |
| 7. | Avicularia very small; zooecia hexagonal | *H. pungens.* |
| | Large avicularia | 8. |
| 8. | Lower face smooth or tubercular, two large avicularia | *H. alifera.* |
| | Lower face of the zoarium perforated; one large and one small avicularium | *H. radicata.* |
| 9. | No mucro | 10. |
| | Mucro present | 11. |
| 10. | Peristome thin; two large avicularia, ovicell smooth | *H. alifera.* |
| | Peristome thin; one submedian avicularium, ovicell with small pores | *H. punctata.* |
| | Peristome very thick; two or three small avicularia; ovicell smooth | *H. crassicollis.* |
| 11. | Two large avicularia | *H. ligulata.* |
| | Two small avicularia | 12. |
| 12. | Enormous mucro with pallet; three rows of areolae | *H. axiculata.* |
| | Small mucro; tuberosities radial on the frontal | *H. tuberosa.* |

### Genus HIPPODIPLOSIA Canu, 1916.

1916. *Hippodiplosia* CANU, Les Bryozoaires du Sud Ouest de la France, Bulletin Société Geologique France, ser. 4, vol. 14, p. 326.

The poster is nearly as large as the anter. The operculum is somewhat narrowed laterally at the site of the cardelles. The operculum always closes the ovicell, which is hyperstomial. The frontal is a tremocyst. There are some spines and some avicularia. 16–18 tentacles.

*Genotype.*—*Hippodiplosia* (*Eschara*) *pallasiana* Moll, 1803.

*Range.*—Jacksonian-Recent.

In this genus the vanna is very large; it is the opening of a compensation sac, probably larger than in *Hippoporina* Neviani, 1895. Consequently the tentacles ought to be more numerous or larger. Calvet reports 16 to 17 tentacles in the genotype. On the other hand, one can suppose that a larger vanna permits simply more rapid egress of the tentacles as an immediate compensation, since the compensatrix is smaller in this group than in *Schizoporella*.

The Eocene species of the genus are rather different from those of the Miocene. It is probable that when the physiology of the avicularia is better known some restrictions will be necessary.

The living species of this genus are:

*Hippodiplosia* (*Eschara*) *pallasiana* Moll, 1803.
*Hippodiplosia* (*Lepralia*) *vestita* Hincks, 1885.

The fossil species are:

*Hippodiplosia* (*Lepralia*) *rarepuncta* Reuss, 1847. Tortonian.
*Hippodiplosia* (*Lepralia*) *planiceps* Reuss, 1847. Tortonian.
*Hippodiplosia* (*Lepralia*) *semicristata* Reuss, 1847. Tortonian.
*Hippodiplosia* (*Lepralia*) *clavata* Manzoni, 1874. Tortonian.
*Hippodiplosia* (*Lepralia*) *auingeri* Reuss, 1847. Tortonian.

*Hippodiplosia* (*Lepralia*) *asperrima* Reuss, 1847. Tortonian.
*Hippodiplosia* (*Lepralia*) *aperta* Manzoni, 1874. Tortonian.
*Hippodiplosia* (*Lepralia*) *megalota* Reuss, 1847. Tortonian.
*Hippodiplosia* (*Eschara*) *ampla* Reuss, 1847. Tortonian.
*Hippodiplosia* (*Eschara*) *biauriculata* Reuss, 1847. Tortonian.
*Hippodiplosia* (*Eschara*) *oculata* Manzoni, 1871. Tortonian.
*Hippodiplosia granulosa* Canu, 1915. Aquitanian.
*Hippodiplosia verrucosa* Canu, 1915. Aquitanian.

### HIPPODIPLOSIA VESPERTILIO, new species.

Plate 52, figs. 5–12.

*Description.*—The zoarium is free, formed of two lamellae fused together and inseparable; the fronds are narrow and bear 4 to 6 longitudinal rows of zooecia. The zooecia are long, distinct, sinuous, claviform; the frontal is convex; it is a thick tremocyst with tubules resting on a very thin, perforated olocyst. The aperture is elliptical, elongated, provided with two very small, inconstant cardelles. The ovicell is globular, little salient, little imbedded in the distal zooecia, closed by the operculum when it opens; it is surrounded by areolae. Two tubular symmetrical avicularia open on each side of the aperture.

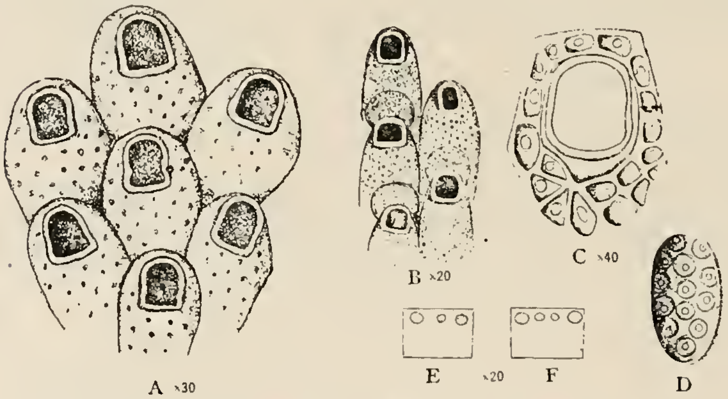

FIG. 117.—Genus *Hippodiplosia* Canu, 1916.

A–F. *Hippodiplosia pallasiana* Moll, 1803. A. Ordinary zooecia, × 30. B. Ovicelled zooecia, × 20. (A, B after Hincks, 1880.) C. Young zooecium, × 40. D. Multiporous septula. E. Distal wall, × 20. F. Lateral wall, × 20. (C–F after Levinsen, 1894.)

*Measurements.*—Aperture $\left\{\begin{array}{l} ha=0.15 \text{ mm.} \\ la=0.11 \text{ mm.} \end{array}\right.$ Zooecia $\left\{\begin{array}{l} Lz=0.60\text{–}0.75 \text{ mm.} \\ lz=0.33 \text{ mm.} \end{array}\right.$

*Variations.*—In the interior (fig. 9) the aperture is oblique; the tubules are visible by transparency through the very thin olocyst. The longitudinal section (fig. 7) shows zooecial alternation due to the closeness of the border of the zoarium; there is a large distal septula and we are able to verify five or six lateral septulae. The longitudinal section (fig. 10) indicates that the operculum ought to close the ovicell in opening, although we cannot be rigorously certain of this. It is evident that if the ovicell was closed by a special membrane, it would be necessary to create a new genus to receive this species. The ovicelled specimens are very rare and we were not able to prepare many sections.

The last tubules of the distal zooecia form on the ovicell a circle of areolae; it appears to be formed by a thickening of the olocyst. The two avicularia are very constant; they give to the zooecia a vague aspect of a *bat's head.*

*Affinities.*—The zooecia much resemble those of the genus *Hippozeugosella;* they differ from it in the absence of a small, distal tongue; their mode of gemmation is also different.

This species differs from *Hippodiplosia petiolus* Lonsdale, 1845, and from *Hippodiplosia falcifera* in the very constant presence of two oral symmetrical avicularia and in its very narrow zoarium.

*Occurrence.*—Middle Jacksonian: Wilmington, North Carolina (common); near Lenuds Ferry, South Carolina (common).

*Cotypes.*—Cat. No. 64095, U.S.N.M.

### HIPPODIPLOSIA PETIOLUS Lonsdale, 1845.

Plate 52, figs. 1–4.

1845. *Eschara petiolus* LONSDALE, Account of twenty-six species of Polyparia obtained from the Eocene Tertiary formation of North America, Quarterly Journal Geological Society, London, vol. 1, p. 528, text figure.

*Measurements.*—Aperture $\begin{cases} ha=0.15 \text{ mm.} \\ la=0.10 \text{ mm.} \end{cases}$ Zooecia $\begin{cases} Lz=0.80\text{–}0.90 \text{ mm.} \\ lz=0.30\text{–}0.32 \text{ mm.} \end{cases}$

We have had the good fortune to find some specimens of this species which no observer has noted since 1845. There are no cardelles present. The ovicell is little salient; it is bordered by areolae and garnished with short radiating costules; it is open above the aperture, but lower than the poster; it may therefore be closed by the operculum, for its exterior orifice is identical with the interior aperture and with the neighboring apertures (fig. 4). The frontal is a tremocyst with tubules supported by a very thin olocyst (fig. 3), with which it is closely joined. These tubules are rather large; they are developed irregularly and give to the zooecia this "increased convexity," noted by Lonsdale (fig. 2). There is sometimes a small avicularium to the right or left of the aperture. The tremopores are easily filled up in fossilization.

*Affinities.*—Its zoarium is formed of large bilamellar fronds like *Hippodiplosia falcifera*, but the present species differs in the practical absence of avicularia and in its smaller tremopores.

The species differs from *Hippodiplosia vespertilio* in the absence of avicularia and in its large, expanded fronds.

*Occurrence.*—Middle Jacksonian: Eutaw Springs, South Carolina (rare).

*Plesiotypes.*—Cat. No. 64094, U.S.N.M.

### HIPPODIPLOSIA FALCIFERA, new species.

Plate 52, figs. 13–16.

*Description.*—The zoarium is free, formed of two lamellae, back to back, and inseparable; the fronds are wide, large, and flabellate. The young zooecia are distinct, elongated, elliptical; the frontal is convex and formed of a thick tremocyst with large tubules resting on a very thin perforated olocyst. The aperture is elliptical, somewhat elongated; the anter is separated by two very small cardelles from a poster somewhat smaller. The avicularium is long, thin, provided with a pivot; it is placed laterally under the aperture; the beak is *falciform.* The old zooecia are indistinct.

*Measurements.*—Aperture $\left\{\begin{array}{l} ha=0.15\text{ mm.} \\ la=0.12\text{ mm.}\end{array}\right.$ Zooecia $\left\{\begin{array}{l} Lz=0.60\text{–}0.70\text{ mm.} \\ lz=0.30\text{–}0.35\text{ mm.}\end{array}\right.$

*Affinities.*—Only the two figured specimens have been found; apparently the proliferation of this species does not correspond to the zoarial vigor. In the old zooecia the tubules are very long; the avicularia immersed between them are hardly visible.

The species differs from *Hippodiplosia vespertilio* in the presence of its large falciform avicularium, which attains a length of 0.35 mm.

*Occurrence.*—Middle Jacksonian (Castle Hayne limestone): Wilmington, North Carolina (very rare).

*Cotypes.*—Cat. No. 64096, U.S.N.M.

### HIPPODIPLOSIA MAGNIPOROSA, new species.

Plate 87, figs. 7–9.

*Description.*—The zoarium is hollow, cylindrical, branched, unilamellar, rarely plurilamellar; it incrusts small algae. The zooecia are little distinct, elongated, almost cylindrical; the frontal is a tremocyst with *large* funnel-shaped *pores* resting on an olocyst perforated by small corresponding pores. The aperture is almost orbicular and formed of a large anter separated from a small concave poster by two very salient, triangular cardelles; the peristome is often very wide, smooth, and very little salient. The ovicell is embedded in the distal zooecium, it is hyperstomial and opens above the aperture by a thin slit; it is of the same nature as the frontal. Often the coalescence of two tremopores determines the formation of a small lateral avicularium with pivot.

*Measurements.*—Aperture $\left\{\begin{array}{l} ha=0.20\text{ mm.} \\ la=0.15\text{ mm.}\end{array}\right.$ Zooecia $\left\{\begin{array}{l} Lz=0.75\text{ mm.} \\ lz=0.40\text{ mm.}\end{array}\right.$

*Variations.*—The lateral avicularium is very inconstant. The young zooecia (fig. 7) have a thin peristome, somewhat prominent in front. Sometimes the tremocyst is detached from the underlying olocyst (fig. 9).

*Affinities.*—This species differs from *Hippodiplosia petiolus* Lonsdale, 1845, in its hollow zoarium and its shorter zooecia.

It differs from *Hippodiplosia strangulata* in its shorter aperture and in the absence of a peristomial avicularium.

*Occurrence.*—Vicksburgian (Marianna limestone): Salt Mountain, 5 miles south of Jackson, Alabama (rare).

Vicksburgian (Red Bluff clay): Seven and one-half miles southwest from Bladen Springs, Alabama (rare).

*Cotypes.*—Cat. Nos. 64278, 64279, U.S.N.M.

### HIPPODIPLOSIA BACCATA, new species.

Plate 87, figs. 5, 6.

*Description.*—The zoarium incrusts shells. The zooecia are short, little distinct; the frontal is somewhat convex; it is formed of a tremocyst with widened pores surmounting an olocyst with very small pores; between the tremopores there are some very small *pearl-like* tuberosities. The aperture is somewhat oval, the point below; the peristome is wide, smooth, a little salient, complete. The ovicell is hyperstomial and very fragile. On the same peristome, and placed laterally, there is a small avicularium (?).

*Measurements.*—Aperture $\left\{\begin{array}{l} ha=0.10\text{ mm.}\\ la=0.10\text{ mm.}\end{array}\right.$ Zooecia $\left\{\begin{array}{l} Lz=0.30\text{ mm.}\\ lz=0.20\text{ mm.}\end{array}\right.$

*Occurrence.*—Vicksburgian (Byram marl): Byram, Mississippi (common).

Vicksburgian (Red Bluff clay): Red Bluff, Wayne County, Mississippi (rare).

*Cotypes.*—Cat. No. 64277, U.S.N.M.

### HIPPODIPLOSIA STRANGULATA, new species.

Plate 87, figs. 10–13.

*Description.*—The zoarium is unilamellar; it incrusts algae or shells. The zooecia are elongated, distinct, fusiform; the frontal is convex and formed of a thick tremocyst with large pores. The apertura is elliptical, quite elongated, a little *constricted* in its lower parts, and formed of a large anter, separated from a smaller poster by two salient cardelles; it is buried by the development of a small peristomie; the peristome is thin, salient, without spines. The ovicell is large, globular, salient, ornamented with pores somewhat smaller than those of the frontal; it is hyperstomial, imbedded in the distal zooecium; it opens into the peristomie. In the peristomie itself or on the peristome there is a quite small orbicular avicularium.

*Measurements.*—Apertura $\left\{\begin{array}{l} ha=0.20\text{–}0.22\text{ mm.}\\ la=0.14\text{–}0.15\text{ mm.}\end{array}\right.$ Zooecium $\left\{\begin{array}{l} Lz=0.70\text{–}0.77\text{ mm.}\\ lz=0.30\text{–}0.35\text{ mm.}\end{array}\right.$

*Variations.*—The micrometric dimensions of this species vary much and are of little use; this is the habitual rule of species growing upon various kinds of substrata; there are some wide zooecia (fig. 11), some narrow zooecia (fig. 10) and some bordered zooecia (fig. 12).

Exteriorly this species has the aspect of *Porella;* it has all the essential characters; tremocyst, peristomial avicularium and ovicell opening into the peristomie. The two cardelles alone reveal to us a different hydrostatic system. The reader may be convinced of this by consulting our anatomical tables of the Hippoporinae and Smittinidae and in comparing their compensatrices. Moreover, species of this sort have a chitinous operculum very different from the opercula of Smittinidae, as it is easy to observe, notably in *Eschara lamellosa.* The absence of the chitinous appendages and of the polypide is often very unfortunate for the paleontologist.

because he must draw on his personal experience for the positive elements of appreciation.

*Affinities.*—The species differs from *Hippodiplosia magniporosa*, in which the zoarium is also unilamellar, in the greater length of its apertura and zooecium, chiefly in the presence of the median peristomial avicularium.

*Occurrence.*—Vicksburgian (Marianna limestone): West bank of Conecuh River, Escambia County, Alabama (very rare); Murder Creek, east of Castlebury, Conecuh County, Alabama (rare); near Claiborne, Monroe County, Alabama (rare).

Vicksburgian (Byram marl): Byram, Mississippi (very rare); Vicksburg, Mississippi (rare in the upper beds).

*Cotypes.*—Cat. Nos. 64280, 64281, U.S.N.M.

### Genus HIPPOZEUGOSELLA Canu and Bassler, 1917.

1917. *Hippozeugosella* CANU and BASSLER, Synopsis of American Early Tertiary Cheilostome Bryozoa, Bulletin 96, United States National Museum, p. 42.

The ovicell is hyperstomial, its orifice is large, without rapport with the operculum, and is closed by a special membrane. The aperture is elliptical; two small cardelles separate the anter from the somewhat smaller poster. The frontal is a tremocyst with small pores. The zoarium is free; the zooecia are joined two by two. No spines. Avicularia present.

*Genotype.*—*Hippozeugosella* (*Bactridium*) *hagenowi* Reuss, 1847.

*Range.*—Priabonian-Miocene.

The only species known are *Bactridium hagenowi* Reuss, 1847, of the Priabonian and *Cucullipora tetrasticha* MacGillivray, 1895, from the Miocene.

This genus embraces the two ancient genera *Bactridium* Reuss, 1869, and *Cucullipora* MacGillivray, 1895, with limits still more extended.

*Bactridium* was created in 1847 by Reuss with unilamellar and biserial species. The first three species belong to *Scrupocellaria*. Again, in 1869, he maintained his genus, but with *Bactridium hagenowi* Reuss, 1847, as a type and with a definition based upon the zoarium. In 1891, Waters in studying this species discovered that it had a schizoporellidan aperture. It is very difficult to establish the limits between the schizoporellidan and hippoporinan apertures in the fossil forms.

The genus *Cucullipora* MacGillivray, 1895, embraces the bilamellar and biserial species in which the orifice is provided with labial processes. The inconstance of the latter does not permit them to be considered as generic characters. They occur in other genera, such as *Watersipora*, *Lagenipora*, etc.

In the American Tertiary we have one unilamellar, biserial species. Five other species are bilamellar and biserial; the edge of the two lamellae is visible laterally with a very characteristic aspect. This edge is hidden in a single species (*Hippozeugosella sexordinata*) by the addition of two supplementary rows. In all these species the mode of ramification is identical. Each new branch is formed by the union of two zooecia arising from two consecutive zooecia (pl. 53, fig. 4). Finally, the mode of gemmation and of the pairing of zooecia reminds one of *Catenicella* Audouin, 1826, *Ichthyaria* Busk, 1884. and *Urceolipora* MacGillivray, 1880, but it is impossible to confuse them, as these genera have quite different characters. *Catenicella* possesses gonoecia; *Urceolipora* is provided with an endozooecial ovicell and *Ichthyaria* has no avicularia.

### HIPPOZEUGOSELLA TEGES Canu and Bassler, 1917.

Plate 53, figs. 1–6.

1917. *Hippozeugosella teges* CANU and BASSLER, Synopsis of American Early Tertiary Cheilostome Bryozoa, Bulletin 96, United States National Museum, p. 42, pl. 4, fig. 5.

*Description.*—The zoarium is free, erect, unilamellar, formed of two longitudinal rows of zooecia; on the dorsal the zooecia are convex, alternate, and they have the aspect of a *mat.* The zooecia are distinct, elongated, hexagonal; the frontal is convex and formed of a tremocyst with very small pores. The aperture is orbicular and formed of a large anter and with a smaller poster separated by two very small cardelles; the peristome is complete, broad, and infundibuliform. On the peristome itself and near the zoarial axis, there is a small round avicularium provided with a pivot. Ovicell?

*Measurements.*—Aperture $\left\{\begin{array}{l} ha=0.11 \text{ mm.} \\ la=0.11 \text{ mm.} \end{array}\right.$ Zooecia $\left\{\begin{array}{l} Lz=0.70\text{–}0.75 \text{ mm.} \\ lz=0.45 \text{ mm.} \end{array}\right.$

*Affinities.*—The frontal pores are very small and are easily filled up. The frontal and the dorsal are covered with very small granulations. The formation of the branches is effected by the union of two zooecia arising from two superposed zooecia (fig. 4).

This species differs from *Bactridium hagenowi* Reuss, 1847, in the absence of a frontal avicularium, in the absence of two peristomial tubercles, and in the absence of areolae on the dorsal.

Waters,[1] in 1891, when studying the species from the Vicentin described the aperture as schizoporellidan. We have not exactly verified this form in our American species. We have discovered two triserial specimens (figs. 5, 6) which are perhaps the bases of the zoaria.

*Occurrence.*—Jacksonian (Zeuglodon zone): Cocoa post office, Choctaw County, Alabama (very rare).

Upper Jacksonian (Ocala limestone): Chipola River, east of Marianna, Jackson County, Florida (common).

*Cotypes.*—Cat. Nos. 62591, 64099, U.S.N.M.

### HIPPOZEUGOSELLA DISTORTA, new species.

Plate 52, figs. 19–21.

*Description.*—The zoarium is free, subcylindrical; it is formed of two lamellae, back to back with two zooecial rows not united by the lateral zooecia. The zooecia are elongated, distinct, fusiform; the frontal is very convex and formed of a tremocyst with small pores. The aperture is elliptical, elongated, imbedded; the peristome is irregular and formed of three distorted lamellae leaving between them a double rounded indentation. The ovicell is globular, salient, ornamented with small pores, as the frontal; its orifice is very large and placed above the aperture. In the peristomie itself there is a small avicularium.

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[1] 1891. Waters, North Italian Bryozoa, Quarterly Journal Geological Society, London, vol. 47, p. 7.

*Measurements.*—Aperture $\left\{\begin{array}{l} ha=0.13\text{ mm.}\\ la=0.09\text{ mm.}\end{array}\right.$ Zooecia $\left\{\begin{array}{l} Lz=0.75\text{ mm.}\\ lz=0.40\text{ mm.}\end{array}\right.$

*Variations.*—The labial processes which form the peristomie give to the species a *deformed* and curious aspect; they are very fragile and break very easily in fossilization. The broken portion shows the small peristomial avicularium.

The mode of gemmation is interesting. It occurs on the edge; the visible zooeciules form the base of the distal zooecia of the other face.

*Affinities.*—This species differs from *Hippozeugosella* (*Cucullipora*) *tetrasticha* MacGillivray, 1895, in its smaller dimensions and its avicularium much smaller and never frontal.

It differs from *Hippozeugosella arcuata* in the absence of the peristomial tongue and in the larger development of its labial processes.

The only specimen found in here figured.

*Occurrence.*—Middle Jacksonian: Eighteen miles west of Wrightsville, Johnson County, Georgia (very rare).

*Holotype.*—Cat. No. 64098, U.SN.M.

### HIPPOZEUGOSELLA ARCUATA, new species.

Plate 53, figs 21–25.

*Description.*—The zoarium is free, bilamellar; each lamella is biserial. The zooecia are distinct, elongated, *arched;* the frontal is very convex; it is formed of a direct tremocyst with rather large pores. The aperture is oblique, elliptical or orbicular, imbedded. The peristome is somewhat salient, and its distal part is a little isolated tongue. The ovicell is hyperstomial, globular, salient, covered with tremopores like the frontal; it is opened by a large orifice above the aperture. No avicularia.

*Measurements.*—Aperture $\left\{\begin{array}{l} ha=0.13\text{–}0.14\text{ mm.}\\ la=0.11\text{–}0.12\text{ mm.}\end{array}\right.$ Zooecia $\left\{\begin{array}{l} Lz=1.10\text{–}1.20\text{ mm.}\\ lz=0.30\text{ mm.}\end{array}\right.$

*Affinities.*—This species is very well characterized by its much arched zooecia. Certain fragments are narrowed toward the bottom as if the zoarium might have been articulated. We have also found a triserial fragment (fig. 25) growing from a single zooecium. The zooecia and the little tongue are quite visible on the edge of the zoarium (fig. 21, 23); between the zooecia there are no zooeciules as in the other species of the same genus.

This species differs from *Hippozeugosella distorta* in its much less developed labial processes and in its arched and much longer zooecia ($Lz=1.10$ instead of 0.75 mm.).

It differs from *Hippozeugosella marginata* in its nonmarginated zooecia, its smaller tremopores, and its zooecial length greater than 1 mm.

*Occurrence.*—Lower Jacksonian (Moodys marl): Jackson, Mississippi (common).

*Cotypes.*—Cat. No. 64103, U.S.N.M.

### HIPPOZEUGOSELLA MARGINATA, new species.

Plate 53, figs. 9–11.

*Description.*—The zoarium is free, bilamellar; the two lamellae are separated by some zooeciules; they are biserial. The zooecia are little elongated, distinct, rhomboidal, separated by a salient *thread;* the frontal is convex and formed by a tremocyst with large polygonal pores. The aperture is elliptical, oblique; the peristome is thin, little salient, interrupted toward the back by a small, inconstant tongue. The ovicell is hyperstomial, globular, salient, covered with tremopores like the frontal.

*Measurements.*—Aperture $\left\{\begin{array}{l} ha=0.15 \text{ mm.} \\ la=0.10 \text{ mm.} \end{array}\right.$ Zooecia $\left\{\begin{array}{l} Lz=0.85\text{–}0.95 \text{ mm.} \\ lz=0.45\text{–}0.55 \text{ mm.} \end{array}\right.$

*Affinities.*—This new species differs from *Hippozeugosella arcuata* in the zooeciules which separate the lamellae (fig. 11) and in its zooecial length smaller and less than 1 mm.

It differs from *Hippozeugosella inflata* in the absence of peristomial avicularia and in the size of its tremopores.

*Occurrence.*—Lower Jacksonian (Moodys marl): Jackson, Mississippi (rare).

*Cotypes.*—Cat. No. 64100,U.S.N.M.

### HIPPOZEUGOSELLA INFLATA, new species.

Plate 53, figs. 12–20.

*Description.*—The zoarium is free, bilamellar; each lamella is biserial. The zooecia are elongated, distinct; the frontal is very *convex* and formed of a tremocyst with very small pores. The aperture is somewhat elliptical or orbicular; two very small cardelles separate the anter from the smaller poster; the peristome is little salient and is interrupted by a small, distal tongue. Two large tubular avicularia are placed symmetrically on each side of the aperture.

*Measurements.*—Aperture $\left\{\begin{array}{l} ha=0.12\text{–}1.14 \text{ mm.} \\ la=0.10 \text{ mm.} \end{array}\right.$ Zooecia $\left\{\begin{array}{l} Lz=0.60\text{–}0.80 \text{ mm.} \\ lz=0.40 \text{ mm.} \end{array}\right.$

*Variations.*—The young zooecia are provided with a small distal tongue (fig. 12) and the avicularia there are replaced by some tuberosities. The edge of the zoarium sometimes presents some intercalated zooeciules (figs. 17, 19), although sometimes they are wanting (fig. 18). Under the influence of calcification the zooecia are flat or very convex (fig. 14) or very wide (fig. 16).

*Affinities.*—This species differs from *Hippozeugosella marginata* and *Hippozeugosella arcuata* in the spesence of the two avicularia.

In its general aspect and its avicularia it has much resemblance to *Hippozeugosella sexordinata;* but it differs in the disposition of its zoarium, which possesses only four longitudinal rows of zooecia.

*Occurrence.*—Middle Jacksonian: One-half mile southeast of Georgia Kaolin Co. Mine, Twiggs County, Georgia; Baldock, Barnwell County, South Carolina.

*Cotypes.*—Cat. Nos. 64101, 64102, U.S.N.M.

### HIPPOZEUGOSELLA SEXORDINATA, new species.

Plate 53, figs. 7, 8.

*Description.*—The zoarium is free, cylindrical, or foliaceous, formed of *six* longitudinal rows of zooecia. The zooecia are distinct, elongated, elliptical or fusiform; the frontal is very convex and formed of a tremocyst with very small pores. The aperture is suborbicular, somewhat imbedded; the peristome is wide, little salient, interrupted by a small distal tongue. The ovicell is globular, salient, hyperstomial, covered with tremopores like the frontal. On the peristome of each side of the aperture there are two small tubular avicularia with a pivot, the beak of which is turned toward the interior of the aperture.

*Measurements.*—Aperture $\left\{\begin{array}{l} ha=0.12 \text{ mm.}\\ la=0.10 \text{ mm.}\end{array}\right.$ Zooecia $\left\{\begin{array}{l} Lz=0.85 \text{ mm.}\\ lz=0.35\text{–}0.40 \text{ mm.}\end{array}\right.$

*Affinities.*—In its exterior aspect, its convex zooecia, and the smallness of its tremopores, this species much resembles *Hippozeugosella inflata.* It differs from it in the somewhat larger zooecial dimensions, and especially in the disposition of its zoarium, parts of which are occupied by two supplementary rows of zooecia.

It therefore approaches close to *Hippodiplosella vespertilio*, but it differs in its mode of bifurcation, which is identical with that of the other species of the same genus. It may be verified by the examination of the interior of the zooecia. Moreover, its ovicell is closed by a special membrane and not by the operculum.

*Occurrence.*—Upper Jacksonian (Ocala limestone): Alachua, Florida.

*Cotypes.*—Cat. No. 64100, U.S.N.M.

### Genus HIPPADENELLA Canu and Bassler, 1917.

This new genus is based upon *Porella* (*Flustra*) *margaritifera* Quoy and Gaymard, 1883, and is described on page 497 under the Smittinidae. We believe the genus to be more naturally placed under the Hippoporae, and for that reason have mentioned it at this point.

### Group 3, PERISTOMELLAE Canu and Bassler, 1917.

*Anatomical bibliography.*—1877. Barrois, Recherches sur l'embryologie des Bryozoaires, pl. 8, figs. 22, 31, 40.—1885. Waters, On the use of the avicularian mandible in the determination of the Cheilostomatous Bryozoa, Journal of the Royal Microscopical Society, ser. 3, vol. 5, pl. 14, fig. 25.—1888. Jullien, Mission scientifique du Cap Horn, pl. 9, fig. 2.—1909. Levinsen, Morphological and systematic studies on the Cheilostomatous Bryozoa, p. 317, pl. 17.

The aperture is oblique without lyrula, cardelles, or rimule. The ovicell is hyperstomial and embedded in the distal zooecia. It opens above (and nearly opposite) the oblique aperture and below the frontal mucro in a locella, where the operculum operates.

The disposition of the ovicell in respect to the operculum is close to that of the Smittinidae. Nevertheless the family differs from the Smittinidae in the absence of a peristomie. Between the aperture and the orifice of the ovicell there is, as it were, a sort of chamber or *locella* in which the operculum moves and takes shelter from extraneous influences. The orifice of this chamber is irregular; it is not a peristomice, since it has no peristome. The tentacles must necessarily be long and flexible.

The locella is the equivalent of the peristomie; it assumes the same functions with great economy of calcification.

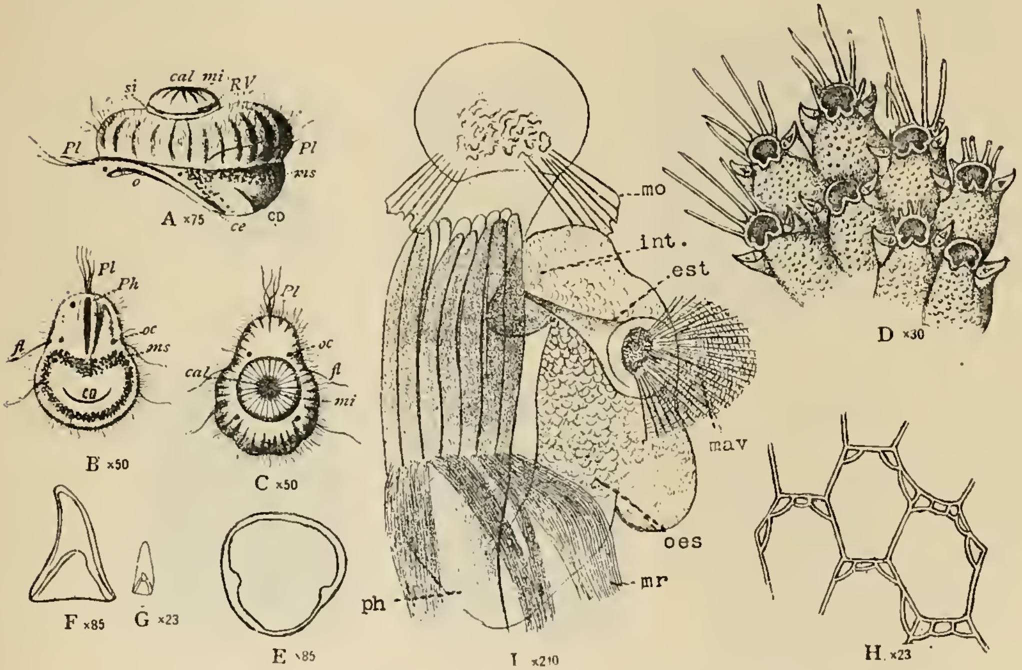

FIG. 118.—Anatomy of the Peristomellae Canu and Bassler, 1917.

A–G. *Peristomella coccinea* Abildgaard, 1805. A. Free larva seen in profile, showing the slightly exposed disposition of the corona and the relatively small size of the terminal bud, × 75. B. Free larva, oral face, × 50. C. Free larva, aboral face, × 50. (A–C after Barrois, 1877.) *cal*, calotte (terminal bud); *CD*, digestive cavity; *fl*, flagellum; *mi*, aboral mesoderm; *ms*, oral (labial) mesoderm; *oc*, oculiform points; *ph*, pharynx; *Pl*, vibratile plume; *RV*, border of the calotte. D. Zooecia, × 30. (After Hincks, 1880.) E. Operculum, × 85. (After Waters, 1878.) F. Mandible, × 85. (After Nordgaard, 1904.) G. Avicularian mandible, × 23. (After Waters, 1885.)

H. *Peristomella prestans* Hincks, 1882. View from the basal surface showing dietellae, × 23. (After Levinsen, 1909.)

I. *Exochella longirostris* Jullien, 1888. Polypide seen anteriorly, × 210; the avicularium has been drawn at its place; its muscular fibers are erect. The feeble development of the stomach is to be noted. (After Jullien, 1888.) *est*, stomach; *int*, intestine (?); *mav*, elevator muscles of the avicularian mandible; *mo*, opercular muscles; *mr*, large retractor muscles of the polypide; *oes*, esophagus; *ph*, pharynx.

The principal genera of this group are:

*Bathosella* Canu and Bassler, 1917.
*Romancheina* Jullien, 1888.
*Peristomella* Levinsen, 1902.

*Exochella* Jullien, 1888.
*Didymosella* Canu and Bassler, 1917.
*Trypematella*, new genus.

They are differentiated from one another in their functions of calcification and their avicularia.

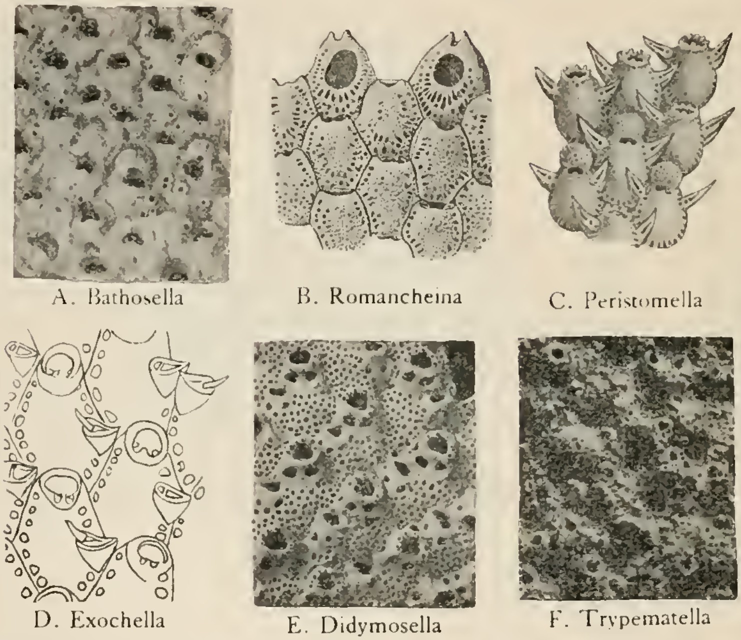
A. Bathosella B. Romancheina C. Peristomella
D. Exochella E. Didymosella F. Trypematella

Fig. 119.—Genera of the subfamily Peristomellae Canu and Bassler, 1917.

A. *Bathosella aspera* Ulrich, 1901, ×20. Lowest Eocene of Maryland.
B. *Romaneheina martiali* Jullien, 1888, × 20. Recent.
C. *Peristomella coccinea* Abildgaard, 1805. Recent.
D. *Exoehella longirostris* Jullien, 1888, × 31. Recent.
E. *Didymoscella erassa* Canu and Bassler, 1917, × 20. Vicksburgian of Alabama.
F. *Trypematella papulifcra*, new species, × 20. Pleistocene of California.

### Genus BATHOSELLA Canu and Bassler, 1917.

1917. *Bathosella* Canu and Bassler, Synopsis of American Early Tertiary Cheilostome Bryozoa, Bulletin 96, United States National Museum, p. 43.

The aperture is oblique without lyrula, cardelles, or rimule. The ovicell is embedded in the distal zooecia. It opens above the aperture and below the frontal mucro in the locella. The frontal is a thick olocyst more or less covered by a pleurocyst. The zooecia are indistinct. The avicularia are simple and irregularly placed. The areolae are very rare. No spines.

*Genotype.—Bathosella* (*Mucronella*) *aspera* Ulrich, 1901.

*Range.*—Upper Cretaceous-Midwayan.

### BATHOSELLA ASPERA Ulrich, 1901.

Plate 1, figs. 27–31.

1901. *Mucronella aspera* ULRICH, Maryland Geological Survey, Eocene, p. 221, pl. 60, figs. 17, 18.

1907. *Mucronella aspera* WELLER, Geological Survey New Jersey, Paleontology, vol. 4, p. 354, pl. 26, figs. 14, 15.

"Zoarium incrusting, consisting of one or more layers; surface under a low power of magnification, presenting a decidedly rough aspect. Zooecia varying from ovate-hexagonal to subrhomboidal, indistinct externally, arranged more or less irregularly, though the rows are more regular than they may appear at first sight; about six in 2 mm. Apertures rounded or subquadrate, 0.13 mm. in diameter, rendered oblique by the elevation of the more or less strongly swollen posterior margin and the depression of the anterior part. The central portion of the raised lip forms a 'mucro' of greater or less thickness and prominence, the same hiding a minute central tooth beneath it and forming, with the rest of the thickened portion of the lip, a more or less obscure resemblance to the figure W. Behind the lip the surface slopes rapidly and in the most nearly perfect example is granulose. In the depressed space in front of the aperture there are, normally, three small raised avicularia (vibracula?) while a few larger avicularia, differing further from the others in being divided into two unequal parts by a crossbar, are scattered without order among the zooecia. Ooecia are not often seen. When present, they occupy the depressed space in front of the aperture, are cucullate, about as large as the zooecial aperture, and usually bear a furrow running from the summit to the concave edge."

*Measurements.*—Aperture $ha$=0.12 mm. Zooecia $\begin{cases} Lz=0.40\text{–}0.50 \text{ mm.} \\ lz=0.30\text{–}0.32 \text{ mm.} \end{cases}$

There is very little to add to Ulrich's excellent description quoted above. The wall of the ovicell is formed of two calcareous layers, but the upper layer is incomplete and often forms a very narrow collar around the lower one. The avicularia symmetrically disposed on each side of the aperture are not rare. The zoarium is incrusting small shells.

*Occurrence.*—Lowest Eocene (Bryozoan bed at base of Aquia formation): Upper Marlboro, Maryland (rare).

*Geological distribution.*—Cretaceous (Vincentown limesand): Vincentown, etc., New Jersey and Delaware.

*Plesiotype.*—Cat. No. 63782, U.S.N.M.

### BATHOSELLA CINGERANS, new species.

Plate 8, figs. 7–10.

*Description.*—The zoarium is unilamellar, hollow, cylindrical; it creeps on the stems of the small algae which it often entirely *surrounds.* The zooecia are very little distinct, elongated; the frontal is convex and surrounded by a line of rather large areolae. The aperture is oblique, semilunar, and its proximal border is concave. The ovicell is little salient. The avicularium replaces an areola; it is elongated and inconstant.

*Measurements.*—Zooecia $\begin{cases} Lz=0.65\text{–}0.70 \text{ mm.} \\ lz=0.35\text{–}0.40 \text{ mm.} \end{cases}$

*Affinities.*—The abnormal zooecia (fig. 10) are probably hydrostatic zooecia which are intended to buoy up the zoarium when the subtratum is very feeble. The apertures do not appear to be of equal size (fig. 8); but as it is very difficult in drawing under the camera lucida to discover their true plane, it is very probable that the great differences result from deformations due to perspective.

This species differs from *Bathosella aspera* Ulrich, 1901, in its line of areolae and its free and not incrusting zoarium.

It differs from *Bathosella undata* in the presence of a continuous line of areolae around the zooecia and in its unilamellar and not bilamellar zoarium.

*Occurrence.*—Midwayan (Clayton limestone): Mabelvale, near Little Rock, Arkansas (common).

*Holotype.*—Cat. No. 63828, U.S.N.M.

### BATHOSELLA UNDATA, new species.

Plate 8, figs. 3, 4.

*Description.*—The zoarium is free, bilamellar, the two lamellae, back to back, and inseparable. The fronds are *undulated*. The zooecia are indistinct, elongated; the frontal is smooth, very little convex; it bears laterally 3 to 5 areolae. The aperture is very oblique and buried in the locella by a convex mucro and very finely denticulated. The ovicell is scarcely salient; it is deeply imbedded in the distal zooecia and it opens into the locella by a transverse slit.

*Measurements.*—Zooecia $\begin{cases} Lz=0.50\text{–}0.60 \text{ mm.} \\ lz=0.35 \text{ mm.} \end{cases}$

*Affinities.*—This species much resembles *Bathosella aspera* Ulrich, 1901, when the latter is deprived of its avicularia with pivot. It differs from it in its bilamellar and not incrusting zoarium, in its much smaller and more buried ovicell, and in the absence of all frontal avicularia.

*Occurrence.*—Midwayan (Clayton limestone): Mabelvale, near Little Rock, Arkansas (very rare); 1 mile west of Fort Gaines, Georgia (rare).

*Holotype.*—Cat. No. 63827, U.S.N.M.

### Genus ROMANCHEINA Jullien, 1888.

1888. *Romancheina* JULLIEN, Mission Scientifique du Cap Horn, vol. 6, Zoologie, Bryozoaires, p. 62.

The aperture is oblique without lyrula, cardelles or rimule. The ovicell is imbedded in the distal zooecia. It opens above the aperture and below the frontal mucro in a locella. The frontal is a tremocyst with pores more or less large. The ovicell is much smaller than the zooecia; the mucro is wide and convex. The avicularia are triangular, thin, transverse, rarely disposed symmetrically. Four spines. Back of the apertura there is a distal armature bearing laterally two large condyles; these condyles limit the orifice of the compensatrix.

*Genotype.*—*Romancheina martiali* Jullien, 1888.

*Range.*—Jacksonian-Recent.

### ROMANCHEINA HEXAGONA, new species.

Plate 53, fig. 26.

*Description.*—The zoarium incrusts free bryozoa. The zooecia are large, somewhat elongated, *hexagonal*, enlarged in the median part; the frontal is convex and formed of a tremocyst with numerous small pores in quincunx. The apertura is semilunar somewhat elongated, removed from the distal border of the zooecium; the peristome is little salient, very thick, ornamented with 4 distal, hollow spines with a proximal mucro little salient. The ovicell is large, little convex, of the same nature as the frontal; it is hyperstomial, deeply imbedded in the distal zooecium and it opens into the peristomie. The two symmetrical avicularia are thin, very long, disposed transversally, and with very pointed beak.

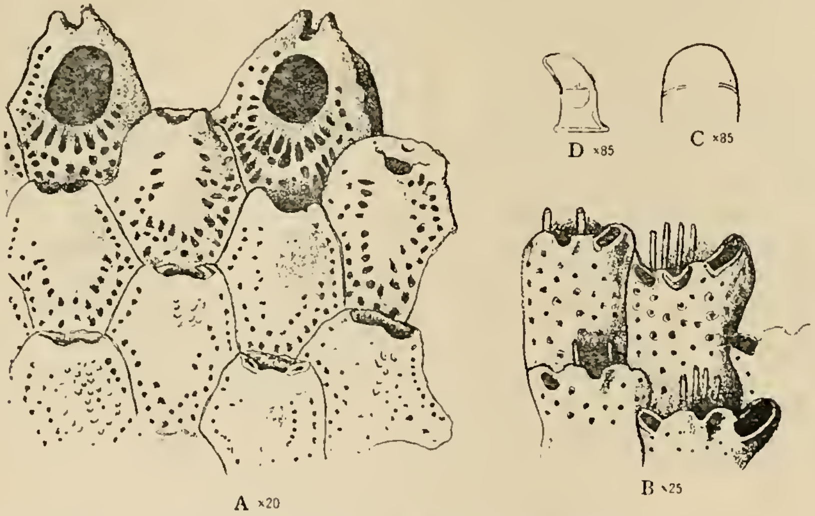

Fig. 120.—Genus *Romancheina* Jullien, 1888.

A. *Romancheina martiali* Jullien, 1888. Zooecia, × 20. (After Jullien, 1888.)

B–D. *Romancheina prestans*, var. Waters, 1889 (not Hincks). B. Zooecia with cleft mucro, × 25. C. Operculum × 85. D. Avicularian mandible, × 85. (After Waters, 1889.)

*Measurements.*—Zooecia $\left\{\begin{array}{l} Lz=0.60\text{–}0.80\text{ mm.} \\ lz=0.60\text{–}0.70\text{ mm.}\end{array}\right.$ Apertura $\left\{\begin{array}{l} la=0.10\text{ mm.} \\ ha=0.12\text{ mm.}\end{array}\right.$

*Affinities.*—This species differs from *Romancheina parvipunctata* in its nonterminal and nonoblique apertura, the distal part of the peristome being on the same level as the proximal portion, in its less salient mucro and in its greater zooecial width.

The only specimen found has been figured.

*Occurrence.*—Middle Jacksonian (Castle Hayne limestone): Wilmington, North Carolina (very rare).

*Holotype.*—Cat. No. 64104, U.S.N.M.

### ROMANCHEINA PARVIPUNCTATA, new species.

Plate 54, figs. 1–4.

*Description.*—The zoarium is incrusting. The zooecia are distinct, irregular, very wide; the frontal is convex and formed of a tremocyst with small pores placed on a perforated olocyst; the mucro is distinct, salient, tubular. The aperture is very oblique and hidden in the locella by a mucro. The ovicell is small, little salient, of the same nature as the frontal; it opens well below the mucro. The avicularia are transverse, triangular, with a pivot, placed on each side of the aperture.

*Measurements.*—Aperture $ha=0.14$ mm. Zooecia $\begin{cases} Lz=0.56\text{–}0.60 \text{ mm.} \\ lz=0.50\text{–}0.60 \text{ mm.} \end{cases}$

*Variations.*—The two avicularia are small and rarely placed symmetrically; more often one of them is of much larger dimensions. Their disconcerting irregularity is inexplicable, for utility takes precedence of fantasy in the animal kingdom. The ancestrula is a quite small zooecium with a frontal much reduced (fig. 4). The number of spines varies from two (figs. 1, 2) to four (fig. 4). The ovicell is always less wide than the zooecia (figs. 1, 2). The tremopores are so small that they are easily filled up; the frontal appears more or less smooth. In the interior the aperture is bordered laterally by two large condyles (fig. 3).

*Occurrence.*—Middle Jacksonian: Wilmington, North Carolina (rare); near Lenuds Ferry, South Carolina (rare); Eutaw Springs, South Carolina (very rare).

*Cotypes.*—Cat. No. 64105, U.S.N.M.

### Genus PERISTOMELLA Levinsen, 1902.

1902. *Peristomella* Levinsen, Studies on Bryozoa, Videnskabelige Meddelelser fra den naturhistoriske Forening Kjobenhavn, p. 26.

The aperture is oblique without lyrula, cardelles, or rimule. The ovicell is hyperstomial and embedded in the distal zooecia. It opens above the aperture and below the frontal mucro in a locella. The frontal is an olocyst perforated by some areolae and covered by a pleurocyst; the mucro is very salient, generally small and triangular. The avicularia are large and transverse; four distal spines. Dietellae. Neither armature nor condyles back of the apertura.

*Genotype.*—*Peristomella* (*Cellepora*) *coccinea* Abildgaard, 1805.

*Range.*—Lutetian-Recent.

The fossil species of this genus are:

*Peristomella* (*Lepralia*) *peregrina* Manzoni, 1889.

*Peristomella* (*Lepralia*) *fulgurans* Manzoni, 1870.

*Peristomella* (*Lepralia*) *mamillata* Wood, 1857.

*Peristomella* (*Eschara*) *alifera* Reuss, 1869.

*Peristomella* (*Mucronella*) *inhabilis* Koschinsky, 1885.
*Peristomella* (*Lepralia*) *strenuis* Manzoni, 1869.
*Peristomella* (*Lepralia*) *laciniata* Seguenza, 1879.
The recent species are:
*Peristomella* (*Smittia*) *jacksoni* Waters, 1896.
*Peristomella* (*Mucronella*) *praestans* Hincks, 1882 (not Waters, 1904).
*Peristomella* (*Mucronella*) *contorta* Busk, 1854.
*Peristomella* (*Mucronella*) *labiata* Busk, 1876.
*Peristomella* (*Escharella*) *costifera* Osburn, 1914.

### PERISTOMELLA COCCINEA Abildgaard, 1805.

Plate 87, fig. 18.

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This cosmopolitan species is very widespread in Europe since the Lutetian. in its normal form. Here in America it does not begin until the Vicksburgian and it is not abundant.

The characteristics of this species are: (1) A peristome complete in front and with 6 spines behind; (2) a small mucro placed in a groove of the peristome; (3) two large oblique avicularia. The orifice is an orbicular external aperture without any connection with the real aperture which is invisible and buried below the mucro.

*Occurrence.*—Vicksburgian (Marianna limestone): West bank of Conecuh River, Escambia County, Alabama (common); Murder Creek, east of Castlebury, Conecuh County, Alabama (rare).

*Geological Distribution.*—Lutetian of Bavaria (Koschinisky) and of Paris (Canu); Priabonian of the Vicentin (Reuss, Gottardi, Waters), of Transylvania (Pergens); Chattian of Germany (Reuss); Burdigalian of the Gard (Pergens); Helvetian of Servia (Pergens), of Italy (Seguenza, Neviani), of the Gard and the Herault (Canu), of Touraine (Canu); Tortonian of Austria-Hungary (Reuss); Zanclean of Italy (Seguenza); Sahelian of Algeria (Canu); Plaisancian of Italy (Manzoni, Neviani); Astian of Italy (Seguenza); Sicilian of Italy (Seguenza, Neviani); Quaternary of Italy (Seguenza, Neviani); Miocene of Australia (Waters).

This species is chiefly littoral. It has been observed in the eastern Atlantic from Madeira to Spitzberg, and in the western Mediterranean from 0 to 100 meters of depth. Nevertheless it has been dredged from 180 meters in the Gulf of Gascony and from 349 meters north of Norway. In this last station the temperature of the depths was +3.5° C.

*Plesiotypes.*—Cat. No. 64285, U.S.N.M.

### PERISTOMELLA COCCINEA RESUPINATA Manzoni, 1875.

Plate 87, fig. 14.

1875. *Lepralia resupinata* Manzoni, Briozoi del pliocene antico di Castrocari, p. 20, p. 11, fig. 26.

1900. *Mucronella coccinea*, var. *resupinata* Neviani, Bryozoa neogenica delle Calabrie Paleontographia Italica, vol. 6, p. 216 (96) (Bibliography regional).

This variety is characterized by the length of the false peristome. Below the external aperture there is an elongated tubular part which is not a true peristomie, but a simple modification of the frontal. This modification probably aims to give a tubular form to the locella and to thus facilitate the extrusion of the tentacles. The interareolar costules are also much accentuated. On the proximal part of the peristome there is a small overhanging mucro.

In France we have never observed this variety. In Italy, according to Seguenza, it is not rare to find some specimens marking the intermediate stages from the type. Here in America the zoarium is incrusting sometimes; more often it is free and more or less vinculariform; it is probable that the axis of such zoaria is formed by a tier of thin filaments of algae around which the zooecia are grouped.

*Occurrence.*—Vicksburgian ("Chimney rock" of Marianna limestone): One mile north of Monroeville, Alabama (rare).

In Europe this variety has been observed since the Helvetian in the same countries as the type species itself, but it has never been mentioned as recent.

It is remarkable that *Peristomella coccinea* Abildgaard, 1805, has disappeared from the western Atlantic and from the Gulf of Mexico since the commencement of the Miocene.

*Plesiotype.*—Cat. No. 64282, U.S.N.M.

### PERISTOMELLA LATICELLA, new species.

Plate 54, figs. 5–7.

*Description.*—The zoarium incrusts shells and bryozoa or creeps over algae. The zooecia are distinct, *wide,* aliform; the frontal is convex, smooth, surrounded by a line of crowded areolae; it is formed of an olocyst covered over and intimately united with a pleurocyst. The aperture is very oblique (about 45°) semilunar, transverse, hidden under a salient and wide mucro; the proximal part of the peristome bears four large spines. The ovicell is hyperstomial, but embedded in the distal zooecia; it is salient, wide, transverse, globular, smooth, surrounded by very small areolae, identical with the frontal. The two avicularia are large, triangular, with pivot, transverse, symmetrically placed. The ancestrula is small.

*Measurements.*—External aperture $lpi$=0.15 mm.

$$\text{Zooecia}\begin{cases} Lz=0.55\text{–}0.60\text{ mm.} \\ lz=0.50\text{–}0.60\text{ mm.} \end{cases}$$

*Affinities.*—The analogy of the ovicellarian walls with the frontal is easy to observe on this species (fig. 6); the pleurocyst is more or less thick. The ancestrula is a small ordinary zooecium.

In its form and general aspect this species is close to *Peristomella alifera* Reuss, 1869, from the Vicentin. It differs from it in its incrusting and non-bilamellar zoarium and in its wide zooecia.

It differs from *Peristomella coccinea* Abildgaard, 1805, in its transverse ovicell, the entire absence of a false peristomie, its much wider zooecia ($lz$=0.50–0.60 mm. and not 0.30 mm.), and the presence of six spines (and not four).

It differs from *Peristomella erecta* and *P. fulgurans* Manzoni, 1870; in its avicularia disposed transversely and not longitudinally.

*Occurrence.*—Lower Jacksonian (Moodys marl): Jackson, Mississippi (rare). Middle Jacksonian: Wilmington, North Carolina (very common); near Lenuds Ferry, South Carolina (rare); 18 miles west of Wrightsville, Johnson County, Georgia (very rare); 3½ miles north of Grovania. Georgia (very rare).

Upper Jacksonian (Ocala limestone): West bank of Sepulga River, Escambia County, Alabama (common).

*Cotypes.*—Cat. No. 64107, U.S.N.M.

### PERISTOMELLA ERECTA, new species.

Plate 87, figs. 16, 17.

*Description.*—The zoarium incrusts shells. The zooecia are distinct, elongated, elliptical; the frontal is convex, smooth, bordered by areolae and covered by a thick pleurocyst filling up the interareolar costules. The aperture is very oblique, invisible, hidden by the mucro; the peristome is little salient, elongated, elliptical; it bears proximally a small mucro triangular and salient; it bears laterally and distally 6 to 8 spines. The hyperstomial ovicell is imbedded in the distal zooecia; it is globular, salient, orbicular, of the same nature as the frontal. The avicularia are *straight*, very long triangular, with pivot, placed symmetrically and longitudinally.

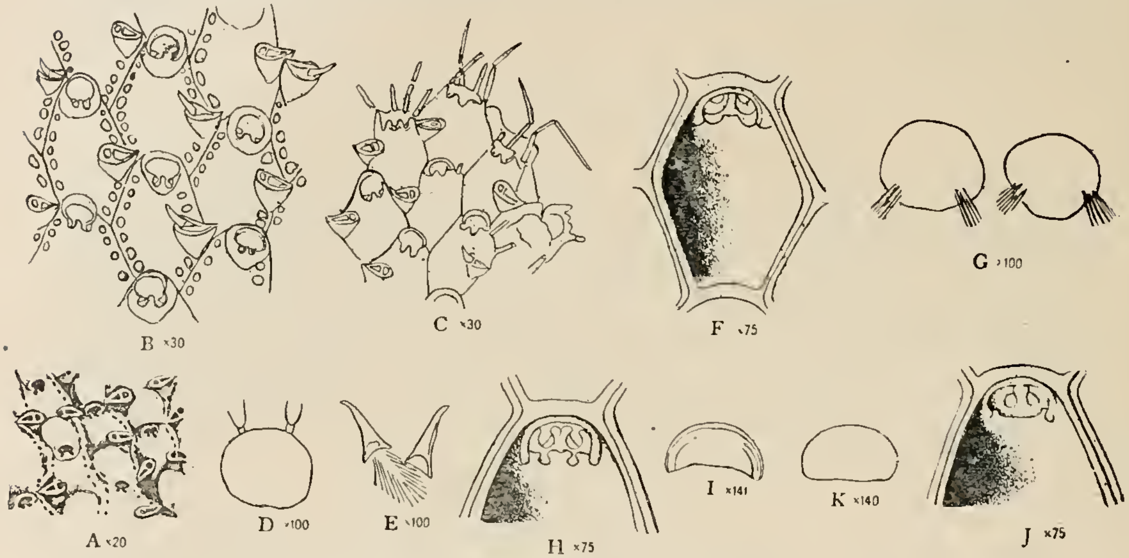

Fig. 121.—Genus *Exochella* Jullien, 1888.

A–G. *Exochella longirostris* Jullien, 1888. A. Ovicelled zooecia, × 20. B. Young unovicelled zooecia, × 30. C. Young zooecia, × 30, provided with marginal articulated spines, 3 or 4 in number. In this singular species the peristome in growing has an abnormal tendency to bear either to the right or to the left, abandoning some of the marginal spines of the orifice. The latter are then isolated outside of the orifice, close to the line of separation of the zooecia. This curious occurrence is observed chiefly on the zooecia bearing only a single avicularium. The appearance of the avicularium seems, therefore, to be the cause of the change of direction of the peristomes of such zooecia. D. Orifice bearing two spines, × 100. E. Avicularia, × 100, one of which is provided with the retractor muscle. (After Jullien, 1888.) F. Interior, showing the aperture and the locella, × 75. G. Opercula, × 100. (After Levinsen, 1909.)

H, I. *Exochella lobata* Levinsen, 1909. H. Interior, showing the apertura, locella, and the vestibular arch, × 75. I. Operculum, × 140. (After Levinsen, 1909.)

J, K. *Exochella tricuspis* Hincks, 1881. J. Interior, × 75, showing the vestibular arch, the apertura, the locella, and three coalesced teeth. K. Operculum, × 140. (After Levinsen, 1909.)

*Measurements.*—External aperture $lpi=0.14$ mm. Zooecia $\begin{cases} Lz=0.60 \text{ mm.} \\ lz=0.35 \text{ mm.} \end{cases}$

*Variations.*—The exterior aspect is quite variable, as in all the species with a pleurocyst; this is not deposited on the young zooecia. The interareolar costules are formed first (fig. 1); their intervals become filled up and the zooecia are then covered by this finely granulated deposit which is characteristic of the pleurocyst.

The texture of the frontal of the ovicell is identical, but the areolae are much smaller. In front of the ovicell 2 or 4 spines often persist. The direction of the avicularia is not very constant; they are sometimes somewhat oblique.

*Affinities.*—This is the American representative of *Peristomella fulgurans* Manzoni, 1870, of the Italian Pliocene. Our species differs from it in a lesser convexity of the frontal and in the avicularia, which are straight (and not somewhat arched) and which never touch the peristome.

This species differs from *Peristomella laciniata* Seguenza, 1879, in the absence of a false peristomie and in the elliptical, elongated form of its external aperture.

It differs from *Peristomella laticella* and *P. coccinea* Abildgaard, 1805, in its avicularia placed longitudinally (and not transversally).

*Occurrence.*—Vicksburgian (Marianna limestone): Near Claiborne, Monroe County, Alabama.

*Cotypes.*—Cat. No. 64284, U.S.N.M.

### PERISTOMELLA FALCIFERA, new species.

Plate 54, figs. 8–10.

*Description.*—The zoarium incrusts shells. The zooecia are large, elliptical, erect; the frontal is very convex, smooth, surrounded by a double line of very small areolae, quite crowded; it is terminated distally by a salient mucro, bifid, oblique. The peristome is quite prominent, thick, garnished with six spines; the locella is very large; the apertura (in the interior) is suborbicular, oblique, entirely hidden by the mucro. The ovicell is very large, globular, quite salient, smooth; it is hyperstomial, placed on the distal zooecium; it opens into the locella by a large orifice, facing the mucro. On each side of the apertura there are two long *falciform* avicularia, parallel to the zooecial axis, the beak above.

*Measurements.*—Zooecia $\begin{cases} Lz = 0.75 \text{ mm.} \\ lz = 0.60 \text{ mm.} \end{cases}$

*Affinities.*—In the disposition of the avicularia, this species is near to *Peristomella fulgurans*, but differs in the form of the straightened avicularia and its larger micrometric dimensions.

It differs from *Lepralia complicata* Reuss, 1847, in its much larger bifid mucro hiding the apertura.

The convexity of the zooecia gives to the interior of the zooecia a very peculiar geometric aspect; the locella appears as a simple slit between the zooecia and the ovicell (fig. 10).

*Occurrence.*—Middle Jacksonian (Castle Hayne limestone): Wilmington, North Carolina (very common).

*Cotypes.*—Cat. No. 64108, U.S.N.M.

### Genus EXOCHELLA Jullien, 1888.

1888. *Exochella* JULLIEN, Mission scientifique du Cap Horn, vol. 6, Zoologie Bryozoaires, p. 55.

The aperture is oblique without lyrula, cardelles or rimule. The ovicell is hyperstomial and imbedded in the distal zooecia. It opens above the aperture and below the frontal mucro in a locella. The operculum is slightly chitinized and not distinctly marked off from the compensatrix. The peristome has three, sometimes coalesced teeth, a median and two lateral. Normally there is an avicularium on each side. Three dietellae. Spines. The frontal is surrounded by areolae.

*Genotype.*—*Exochella longirostris* Jullien, 1888.

*Range.*—Rocanean-Recent.

### Genus DIDYMOSELLA Canu and Bassler, 1917.

1917. *Didymosella* Canu and Bassler, Synopsis of American Early Tertiary Cheilostome Bryozoa, Bulletin 96, United States National Museum, p. 43.

The frontal is a tremocyst. Below the aperture there are two large pores which open into the zooecia, under the operculum. Spines. There is a large marginal avicularium, triangular, with pivot, arranged transversally.

*Genotype.*—*Didymosella* (*Porina*) *larvalis* MacGillivray, 1868.

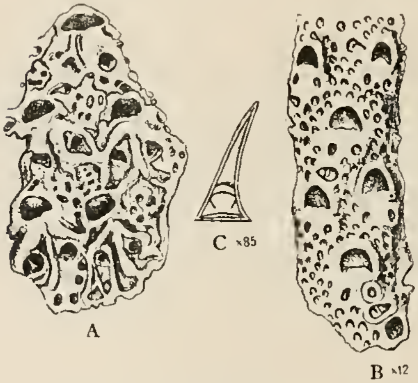

Fig. 122.—Genus *Didymosella* Canu and Bassler, 1917.

A–C. *Didymosella larvalis* MacGillivray, 1868. A. Zooecia. (After MacGillivray, 1895.) B. Zooecia, × 12. (After Waters, 1882.) C. Avicularian mandible, × 85. (After Waters, 1887.)

*Range.*—Vicksburgian-Recent.

We do not know the ovicell of this species and we are ignorant of the function of the two frontal pores. The latter have appeared to us to have some relationship with those resulting from the coalescence of the three labial teeth of *Exochella;* and this simple relation, combined with the presence of a large, marginal avicularium, causes us to classify the genus in the Peristomellae. In reality we have not sufficient data.

#### DIDYMOSELLA CRASSA Canu and Bassler, 1917.

Plate 88, figs. 1–7.

1917. *Didymosella crassa* Canu and Bassler, Synopsis of American Early Tertiary Cheilostome Bryozoa, Bulletin 96, United States National Museum, p. 43, pl. 4, fig. 6.

*Description.*—The zoarium is unilamellar and very *thick;* it creeps over algae. The zooecia are elongated, distinct, in the form of a bottle; the frontal is convex and formed of a tremocyst with large, crowded, tubular pores. The aperture is elliptical and transverse; the salient peristome bears the traces of very small spines; two enormous pores are adjacent to the peristome. The avicularium is marginal, triangular, very large, with pivot, and arranged transversally. The lower face is smooth and presents some large, scattered concavities.

*Measurements.*—Aperture $\left\{\begin{array}{l} ha=0.10\text{ mm.}\\ la=0.11\text{–}0.12\text{ mm.}\end{array}\right.$ Zooecia $\left\{\begin{array}{l} Lz=0.60\text{–}0.70\text{ mm.}\\ lz=0.40\text{ mm.}\end{array}\right.$

*Variations.*—In longitudinal section we are better able to comprehend the organization of this species. In particular the dorsal wall is a very thick olocyst, the cavities observed on the exterior do not perforate it; they limit the zooecia between which they are hollowed out. The large frontal pores open into the same zooecia (fig. 4); the tremopores are tubules; finally the avicularium is a very large chamber hollowed in the thickness of the frontal wall.

The tangential section (fig. 5) reveals the remarkable size of the avicularium, a size which must correspond to a powerful musculature; the frontal is a tremocyst with large pores in the form of tubules; the olocyst which surround the large frontal pores show small vacuoles.

*Affinities.*—This is the American representative of *Didymosella bioculata* Waters of the Priabonian. It differs from this European species in its frontal which is a tremocyst and not garnished with lateral areolae.

It differs from *Didymosella* (*Porina*) *larvalis* MacGillivray, 1868, in its much more numerous tremopores and in its two pores placed lower.

" In recent specimens there is usually a thick epitheca (ectocyst) covering the front of the zooecia, but not closing the peristomial pores. It may possibly be a *Hiantopora.*" (MacGillivray.)

*Occurrence.*—Vicksburgian (Marianna limestone): West bank of Conecuh River, Escambia County, Alabama (common); Murder Creek, east of Castlebury, Conecuh County, Alabama (common); near Claiborne, Monroe County, Alabama (rare); 1 mile north of Monroeville, Alabama (rare); deep well, Escambia County, Alabama (very rare).

*Cotypes.*—Cat. No. 62592, U.S.N.M.

### TRYPEMATELLA, new genus.

*Trypemos*, in allusion to the numerous perforations of the zoarium.

The ovicell is hyperstomial and closed by the operculum for the passage of the eggs. The apertura is semilunar, with proximal border a little concave. The frontal bears some lateral areolar pores (pleurocyst on olocyst). Two large lateral avicularia are placed below the apertura.

*Genotype.*—*Trypematella papulifera*, new species. Pleistocene of California. The type of this genus will be described in a forthcoming publication.

### Group 4, MICROPORELLAE.

The orifice of the compensatrix (ascopore) is distinct and at some distance from the apertura. The ovicell is hyperstomial and closed by the operculum.

The presence of a frontal micropore was considered by Hincks in 1880 as an important family character, but the comparison of the larvae does not bear out this conclusion.

According to Jullien the ascopore is the orifice of a horn-shaped process allowing the exterior to communicate with the tentacular sheath. Harmer and Levinsen believed that this was an optical illusion, and that the ascopore is really the orifice of the compensatrix.

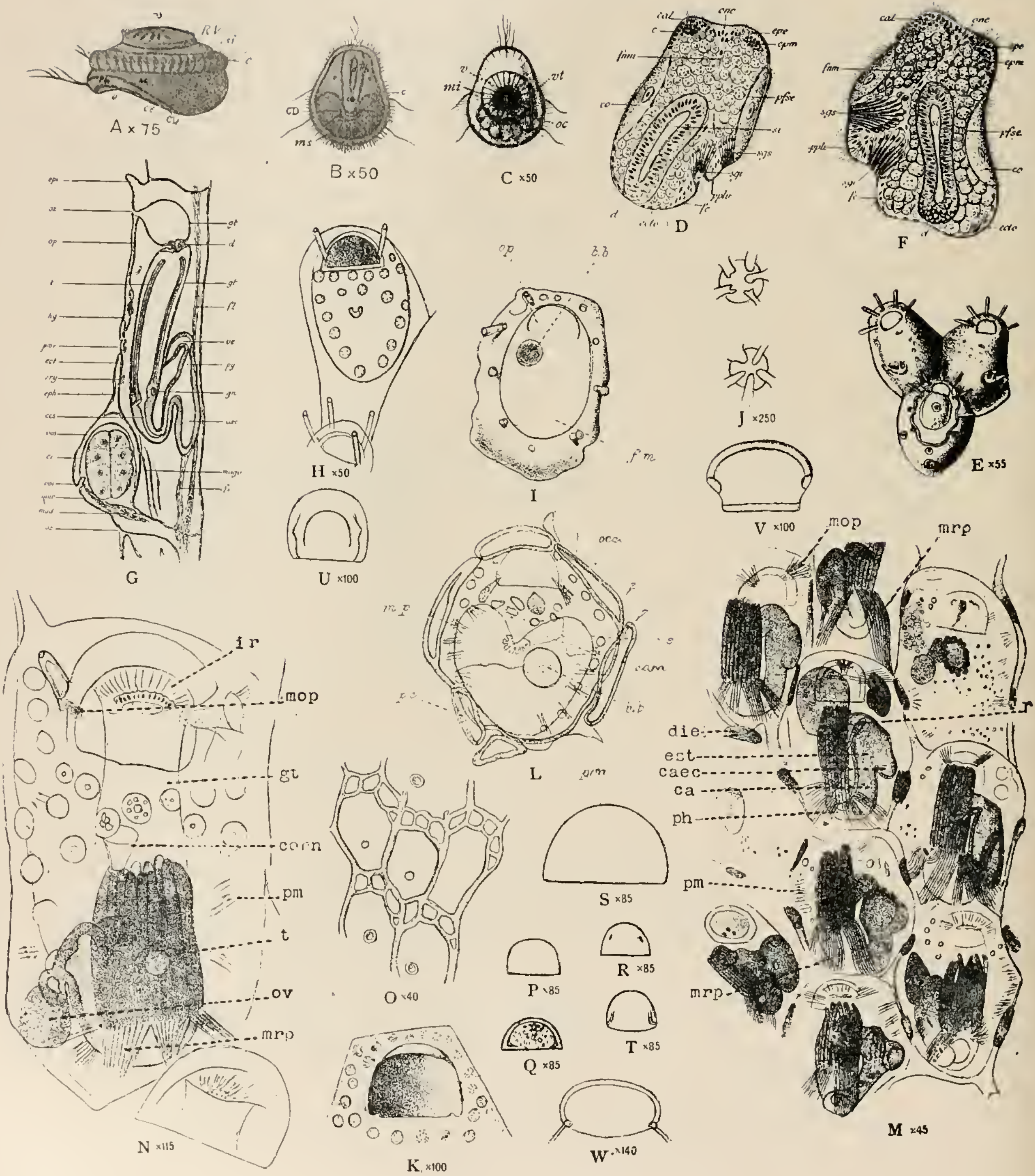
A × 75
B × 50
C × 50
D
E × 55
F
G
H × 50
I
J × 250
K × 100
L
M × 45
N × 115
O × 40
P × 85
Q × 85
R × 85
S × 85
T × 85
U × 100
V × 100
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Fig. 123.—Anatomy of the Microporellae.

FIG. 123.—Anatomy of the Microporellae.

A–E. *Microporella ciliata* Pallas. 1766. A. Profile view of free larva, × 75. B. Free larva, oral view, showing the large radiating elements of the oral mesoderm, × 50. C. Free larva, aboral view, showing the radiating aspect of the calotte, 50. (A–C after Barrois, 1877.)

*c*, corona;
*cal*, calotte (terminal bud);
*CD*, digestive cavity;
*cc*, obscure part between the two branches of the stomach;
*mi*, aboral mesoderm;
*ms*, oral mesoderm;
*O*, ciliated cleft;
*oc*, oculiform points;
*ph*, pharynx;
*RV*, border of the calotte.

D. Median sagittal section of an embryo in one of the last stages of development. (After Calvet, 1900.) E. Ancestrula and two zooecia. The original aperture of the ancestrula, which is surrounded by spines, is almost closed to a pore, × 55. (After Levinsen, 1909.)

F–N. *Microporella malusi* Audouin, 1826. F. Median sagittal section of an embryo just before it emerges. (After Calvet, 1900.) In the course of the neuro-muscular bundles passing from the central nerve organs to the pyriform organ some cellules are seen. The internal sack has a simple form almost regularly cylindrical.

*c*, mantle;
*cal*, calotte (terminal bud);
*co*, corona;
*d*, tampon or inner sac;
*ect*, ectoderm;
*cpe*, ectoderm thickening;
*cpm*, mesoderm thickening;
*fc*, ciliated cleft;
*fnm*, neuro-muscular bundle;
*onc*, central nervous organ of the embryo;
*pfsc*, sub-ectoderm nerve plexus;
*pplv*, papilla of the vibratile plume;
*si*, internal sac;
*sgs*, superior glandular system;
*sgi*, inferior glandular system.

G. Longitudinal section of a bryozoid. (After Calvet, 1900.)

*cacc*, stomachic caecum;
*ci*, incubation cavity;
*cry*. cryptocyst, or skeleton;
*d*, diaphragm;
*eph*, hypostegal epithelium;
*epi*, spine;
*fc*, central funicular cord;
*fl*, lateral funicular cord;
*gn*, nervous ganglion;
*gt*, sub-diaphragm region of the tentacular sheath;
*gt'*, subdiaphragm region;
*hy*. hypostege;
*mud*, dilator muscles of the incubation cavity;
*mugr*, large retractor muscle;
*mur*, retractor muscles of the frontal walls of the lower ovicellarian vesicle;
*oes*, esophagus;
*op*, operculum;
*oz*, zooecial orifice;
*pmc*, median frontal pore;
*py*, pyloris;
*rc*, rectum;
*t*, tentacles;
*voi*, lower ovicellarian vesicle;
*vos*, upper ovicellarian vesicle.

H. Zooecia, × 50. (After Waters, 1903.) I. Ancestrula. The frontal membrane (*fm*) is typically flustrine and bears an opercular valve; its calcareous margin bears ten spines, of which three are oral spines (*op*). The brown body (*bb*) may be noted. (After Harmer, 1902.) J. Frontal pores, × 250. (After Waters, 1914.) K. Aperture, × 100. (After Levinsen, 1909.) L. Basal view of a zooecium which has lost its polypide. (After Harmer, 1902.)

*b*, polypide bud;
*bb*, brown body;
*corn*, cornicula;
*cs*, compensatrix opening by the ascopore (*m. p.*);
*occl*, opercular muscles;
*p. c.*, dietellae;
*z*, neighboring zooecia.

M. Zoarium decalcified, seen posteriorly, × 45. N. Anterior view of a zooecium containing only a young polypide, × 115. (M, N after Jullien, 1888.)

*ca*, cardiac region of the stomach;
*caec*, caecum of the stomach;
*corn*, cornicula;
*dic*, dietella;
*est*, stomach;
*gt*, tentacular sheath;
*ir*, irisoid;
*mop*, occlusor muscles of the operculum;
*mrp*, large retractor muscles of the polypide;
*ov* ovary;
*ph*, pharynx and esophagus;
*pm*, parietal muscles;
*r*, intestine and rectum;
*t*, tentacles.

O. *Microporella flabellaris* Busk, 1852. Dietellae, from the basal surface. Besides the basal wall of the dietellae, the small triangular basal surface of the vibracular chamber is seen lowest down to the right on the four zooecia. On some zooecia the basal surface shows a septula, and on others an opening corresponding with a septula in an opposite zooecium, × 40. (After Levinsen, 1909.)

P–W. Opercula of *Microporella*. *M ciliata* Pallas, 1766. × 85. Q. *M. malusi* Audouin, 1826, × 85. (P, Q after Waters, 1878.) R. *M. parvipora* Waters, 1904, × 85. (After Waters, 1906.) S. *M. divaricata* Canu, 1903, × 85. (After Waters, 1904.) T. *M. flabelligera* Levinsen, 1909, × 85. U. *M. decorata* Reuss, 1847, × 100. V. *M. marginata* Krauss, 1837, × 100. W. *M. flabellaris* Busk, 1852, × 140. (T–W after Levinsen, 1909.)

Levinsen, in 1909, did not recognize the different genera established by authors according to the form of the aperture. We have been able to adopt a number of these genera, employing the principle of the great variations in the function of calcification.

Many species hitherto believed to belong to the Microporellae have been recognized to belong in reality to the Adeonidae.

*Microporella* Hincks, 1877, *Flustramorpha* Busk, 1884, and *Diporula* Hincks, 1879, are referred to this group, the general anatomy of which is illustrated in figure 123. A discussion of the group will be deferred until the publication of our monograph on the later Tertiary Bryozoa of North America.

### Group 5, DIVERS GENERA.

The genera of this section have some peculiar characters which do not permit of their classification in any of the large groups cited; but they appear really to belong to the same general family. The principal of these genera are:

*Houzeauina* Pergens, 1889.
*Cyclicopora* Hincks, 1884.
*Kymella* Canu and Bassler, 1917.
*Cyclocolposa*, new genus.
*Cycloperiella*, new genus.
*Aimulosia* Jullien, 1888.
*Anarthropora* Smitt.

This last genus, devoid of ovicells, belongs perhaps to a distinct family.

### Genus HOUZEAUINA Pergens, 1889.

1889. *Houzeauina* PERGENS, Sur fossilen Bryozoenfauna von Wola Lużanska, Bulletin Société Belge de Geologie, vol. 3, p. 68.

The ovicell is hyperstomial and imbedded in the distal zooecia; it is closed by the operculum. The frontal is an olocyst perforated laterally by some areolae. The avicularium is derived from a lateral areola, but it develops at the middle of the frontal.

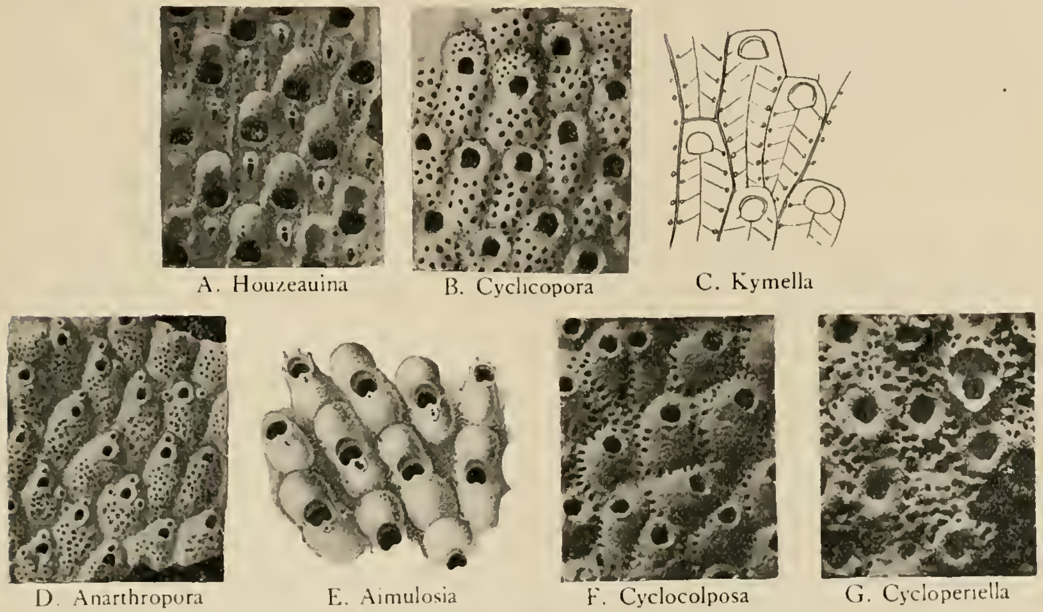
A. Houzeauina B. Cyclicopora C. Kymella
D. Anarthropora E. Aimulosia F. Cyclocolposa G. Cycloperiella

FIG. 124.—Miscellaneous genera of the Escharellidae.

A. *Houzeauina callosa*, new species, × 20. Middle Jacksonian of Georgia.
B. *Cyclicopora colum*, new species, × 20. Vicksburgian of Alabama.
C. *Kymella polaris* Waters, 1904. × 16. Recent.
D. *Anarthropora verrucosa*, new species, × 20. Midwayan of Georgia.
E. *Aimulosia australis* Jullien, 1888. × 25. Recent.
F. *Cyclocolposa perforata*, new species, × 20. Pliocene of South Carolina.
G. *Cycloperiella rubra*, new species. × 20. Miocene of North Carolina.

*Genotype.*—*Houzeauina* (*Eschara*) *parallela* Reuss, 1869.

*Range.*—Jacksonian-Priabonian.

This genus is very remarkable and we have no recent equivalent. We think that the operculum closes at the same time the ovicell and the zooecia; the height of the real aperture is, in effect, somewhat larger than that of the external aperture. This common operculum is of different form from the operculum of the nonovicelled zooecia.

The mode of formation and the origin of the median avicularium is as remarkable as unexpected. It was in studying the interior of the zooecia that we made this discovery. The avicularium develops on a lateral areola slipping under the frontal in the form of a triangle and developed longitudinally at the middle of this frontal (pl. 54, fig. 17).

### HOUZEAUINA ORNATA, new species.

Plate 54, figs. 12–17.

*Description.*—The zoarium is an Eschara the fronds of which reach frequently more than a centimeter. The zooecia are quite elongated, distinct, rectangular, separated by a salient thread; the frontal is flat, smooth, *ornamented* laterally with numerous areolae often very large. The aperture is subcircular. The ovicell is buried in the distal zooecia, globular and salient and has a very fragile olocystal frontal. The avicularium is median, somewhat salient, triangular, the beak turned toward the bottom and provided with a pivot.

*Measurements.*—Aperture $\begin{cases} ha=0.18 \text{ mm.} \\ la=0.14\text{–}0.16 \end{cases}$ Aperture of ovicelled zooecia $\begin{cases} ha=0.10 \text{ mm.} \\ la=0.14 \text{ mm.} \end{cases}$

Zooecia $\begin{cases} Lz=0.80\text{–}0.90 \text{ mm.} \\ lz=0.24\text{–}0.30 \text{ mm.} \end{cases}$

*Variations.*—The dimensions of the aperture which we mention are the maximum; most of the time they vary around 0.12–0.14 mm. by 0.12 mm. The aperture of the ovicelled zooecia is transverse: nevertheless in looking at the base of the locella the zooecial aperture is perfectly visible with a greater height (0.12–0.18 mm. and not 0.10 mm.). If this aperture were closed by an ordinary operculum it would not be able to open exteriorly to allow the passage of the tentacles. It is this which makes us suppose that the ovicelled zooecia have a special operculum. The areolae are small (fig. 14) or large (fig. 13).

The active formation of the pleurocyst gives to the zooecia a remarkable ornamentation (fig. 16) impossible to describe. In the interior (fig. 17) we see a thick olocyst perforated laterally by some very small areolae, and the triangular cavity which is the lodging of the avicularium by which the mesenchymatous elements pass through one of the lateral areola. When the avicularium does not exist (fig. 13) the areolae are larger.

*Affinities.*—This is the American representative of *Houzeauina parallela* Reuss, 1869. It differs from it in its orbicular orifice (and not semilunar) without a straight proximal border.

It differs from *Houzeauina callosa* in its smaller oral dimensions (*la*=0.14, and not 0.18 mm.) in its larger areolae and the much larger frontal callosity.

*Occurrence.*—Middle Jacksonian: Rich Hill, Crawford County, Georgia (common); Baldock, Barnwell County, South Carolina (very common); 3½ miles north of Grovania, Georgia (rare); 3¼ miles south of Perry, Georgia (rare); 18 miles west of Wrightsville, Georgia (common); Eutaw Springs, South Carolina (rare).

*Cotypes.*—Cat. No. 64111, U.S.N.M.

### HOUZEAUINA CALLOSA, new species.

Plate 54, fig. 11.

*Description.*—The zoarium is an Eschara; the partition which separates the two lamellae, back to back, is unique. The zooecia are much elongated, distinct, rectangular, separated by a very prominent thread; the frontal is smooth, flat, garnished laterally with small areolae, of which the two lower are larger than the others. The hyperstomial ovicell is imbedded in the distal zooecia; it is salient and globular and bears in front a perforated *callosity.* The median avicularium is small, triangular, the beak turned toward the bottom, salient, without pivot, but with an opening for the passage of the extensor muscles of the mandible.

*Measurements.*—Aperture $\left\{\begin{array}{l} ha=0.20 \text{ mm.} \\ la=0.18\text{–}0.20 \text{ mm.} \end{array}\right.$ Zooecia $\left\{\begin{array}{l} Lz=0.70\text{–}0.85 \text{ mm.} \\ lz=0.30 \text{ mm.} \end{array}\right.$

Aperture of ovicelled zooecia $\left\{\begin{array}{l} ha=0.15 \text{ mm.} \\ la=0.18\text{–}0.20 \text{ mm.} \end{array}\right.$

*Affinities.*—This species differs from *Houzeauina ornata* in the small perforated frontal callosity of the ovicell, in its smaller areolae and its larger oral dimensions.

Only the figured specimen has been found.

*Occurrence.*—Middle Jacksonian: Eighteen miles west of Wrightsville, Johnson County, Georgia (very rare).

*Holotype.*—Cat. No. 64109, U.S.N.M.

### HOUZEAUINA LIBRATA, new species.

Plate 52, figs. 17, 18; Plate 55, figs. 1–4.

*Description.*—The zoarium is bilamellar, its fronds often claviform. The zooecia are indistinct, elongated; the frontal is convex, smooth, garnished laterally with some very widely spaced areolae, the lower two of which are the larger; a finely granulated pleurocyst is closely united with a thick subjacent olocyst. The aperture is imbedded, semilunar, with a proximal border nearly straight; there are two very small cardelles placed quite low. The avicularium is median, little salient, elliptical; it does not exist on the zooecia provided with two large lower areolae.

*Measurements.*—Aperture $\left\{\begin{array}{l} ha=0.10\text{–}0.14 \text{ mm.} \\ la=0.10\text{–}0.14 \text{ mm.} \end{array}\right.$

Zooecia $\left\{\begin{array}{l} Lz=0.60 \text{ (max. } 0.74 \text{ mm).} \\ lz=0.30\text{–}0.40 \text{ mm.} \end{array}\right.$

*Variations.*—The dimensions of the aperture vary very little and oscillate around 0.12 mm., nevertheless it is sometimes slightly transverse (0.10 by 0.14 mm.) and sometimes a little elongated (0.14 by 0.10 mm.). By rubbing away one face we are able to study the interior of the zooecia; the avicularium is indeed that of *Houzeauina* as it results from a development of the lateral areolae, through which pass the mesenchymatous fibers which unite it to the zooecia. It establishes a phenomenon of *balance*, of equilibrium between this avicularium and the other areolae, chiefly the lower ones, which do not exist on the zooecia deprived of the median avicularium. Canu[1] has already cited an analogous case of equilibrium in *Exochella mutablis* Canu, 1911, from the Rocanean of Argentina. The olocyst is very thick (pl. 55, fig. 5). Finally we have observed two monstrous zooecia (pl. 55, fig. 3).

*Affinities.*—This species is very deceiving, and, without the study of the zooecial interior, it would be impossible to classify it properly. The absence of prominent threads separating the zooecia will suffice to differentiate it from all the others.

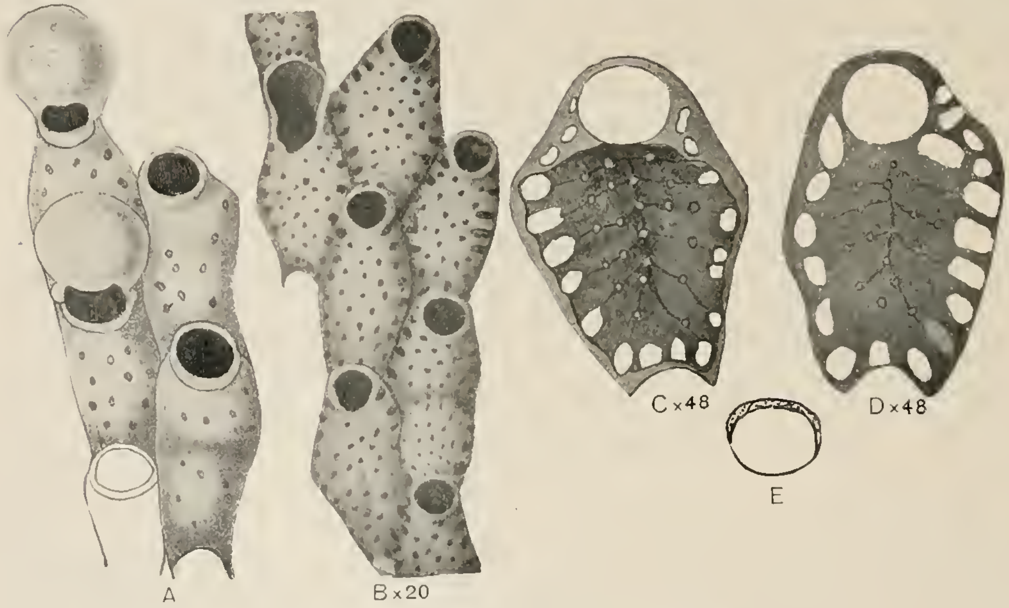

FIG. 125.—Genus *Cyclicopora* Hincks, 1884.

A–E. *Cyclicopora longipora* MacGillivray, 1882. A. Ovicelled zooecia. (After MacGillivray, 1882.) B. Zooecia, × 20, indicating that the lateral pores are areolar. C. Tangential section of the inner face of the frontal wall, × 48, showing the tremopores along the suture lines. D. Tangential section of the external face of the frontal wall, × 48. (After Hennig, 1910.) E. Operculum showing the border very thick and chitinous.

*Occurrence.*—Middle Jacksonian: Wilmington, North Carolina (common); near Lenuds Ferry, South Carolina (very rare).

*Cotypes.*—Cat. No. 64097, U.S.N.M.

### Genus CYCLICOPORA Hincks, 1884.

1884. *Cyclicopora* HINCKS, Polyzoa from Victoria, Annals and Magazine Natural History, ser. 5, vol. 14, p. 279; 1893, ser. 6, vol. 12, p. 143.

The ovicell is hyperstomial and always closed by the operculum. The frontal is a tremocyst with pores in quincunx. There are no cardelles, but the operculum functions as if they existed (as in the genus *Hippodiplosia*). The proximal border of the apertura is straight or somewhat concave. No spines.

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[1] Iconographie Bryozoaires fossiles de l'Argentine, pt. 2, Anales del Museo Nacional de Buenos Aires, vol. 21, p. 263.

*Genotype.*—*Cyclicopora* (*Lepralia*) *longipora* MacGillivray, 1882.

*Range.*—Jacksonian-Recent.

The simplicity of the structure of this genus has been much exaggerated on account of an incomplete observation of the operculum, the ovicell, and the frontal. The axis of rotation of the operculum is at the middle of the aperture; its anterior part is reenforced by a band much more chitinized.

*Cyclicopora polaris* Waters, 1904, belongs to a closely related genus; the operculum bears indeed the same distal sclerite, but its form is different, the frontal is a pleurocyst proceeding from lateral areolae, and there are some spines; this is the genus *Kymella* described on page 428.

Hincks has introduced *Cyclicopora* into a special family, the Cyclicoporidae. This family is perhaps really a good one; the frontal of the two known genera appear to be formed by the consolidation of the primitive costules, as the figures of Hennig and of Waters, which we reproduce, seem to prove. Finally, the operculum has a broad, thickened border, reminding us of the opercula of some *Membranipora*, such as *Membranipora tenuirostris* Hincks, 1880.

### CYCLICOPORA FISSURATA, new species.

Plate 55, fig. 7.

*Description.*—The zoarium is unilamellar and creeps on algae. The zooecia are elongated, distinct, elliptical; the frontal is convex and covered by very large tremopores. The apertura is semilunar with a proximal border somewhat concave; the peristome is wide, complete, hardly salient. On each side of the apertura there are two avicularia, elongated, thin, adjacent to the peristome, the beak directed toward the top.

*Measurements.*—Apertura $\begin{cases} ha=0.20 \text{ mm.} \\ la=0.15\text{–}0.17 \text{ mm.} \end{cases}$ Zooecia $\begin{cases} Lz=0.80\text{–}0.95 \text{ mm.} \\ lz=0.45 \text{ mm.} \end{cases}$

*Affinities.*—The avicularia are seen in perspective; they have the aspect of two *fissures* in the zooecia.

This species differs from *Cyclicopora longipora* MacGillivray, 1882, in its enormous tremopores and its two large oral avicularia.

It differs from *Cyclicopora colum* in its much larger dimensions.

*Occurrence.*—Middle Jacksonian (Castle Hayne limestone): Wilmington, North Carolina (very rare).

*Holotype.*—Cat. No. 64113, U.S.N.M.

### CYCLICOPORA COLUM, new species.

Plate 87, fig. 15.

*Description.*—The zoarium incrusts bryozoa. The zooecia are elongated, distinct, separated by a deep furrow, the frontal is convex and covered with large tremopores, widely spaced. The aperture is semielliptical or semilunar; the proximal border is straight or somewhat concave. The ovicell is globular, salient, covered with smaller tremopores than those of the frontal; it is hyperstomial and always closed by the operculum. One of the lateral tremopores, near the aperture, transforms itself into a small avicularium, simple, somewhat salient, and elliptical.

*Measurements.*—Aperture $\left\{\begin{array}{l} ha=0.12\text{–}0.14\text{ mm.} \\ la=0.14\text{–}0.16\text{ mm.} \end{array}\right.$ Zooecia $\left\{\begin{array}{l} Lz=0.55\text{–}0.60\text{ mm.} \\ lz=0.40\text{ mm.} \end{array}\right.$

*Affinities.*—This species differs from *Cyclicopora longipora* MacGillivray, 1882, in its large tremopores which give it the aspect of a *colander.*

It differs from *Cyclicopora fissurata* in its much smaller dimensions and the absence of elongated, lateral avicularia.

*Occurrence.*—Vicksburgian ("Chimney rock" member of Marianna limestone): One mile north of Monroeville, Alabama (very rare).

*Holotype.*—Cat. No. 64283, U.S.N.M.

### CYCLICOPORA SPONGIOPSIS De Gregorio, 1890.

Plate 88, figs. 8–16.

1890. *Eschara spongiopsis* De Gregorio, Monographie de la Faune Eocenique de Alabama, Annales Geologie et de Paleontologie, Livr. 7, 8, p. 241, pl. 40, fig. 2.

*Description.*—The zoarium is unilamellar, cylindrical, hollow; it surrounds the radicells of small algae. The zooecia are very little distinct, elongated, fusiform; the frontal is little convex, very thick and formed of a tremocyst with large tubular pores resting on a very thin olocyst. The apertura is oval, at the base of a deep peristomie: the peristome is smooth, not salient, and bears from 1 to 4 simple avicularia. The ovicell is hyperstomial, buried in the distal zooecia; it opens into the peristomie, it is ornamented with large pores analogous to those of the frontal.

*Measurements.*—Apertura $\left\{\begin{array}{l} ha=0.20\text{ mm.} \\ la=0.15\text{ mm.} \end{array}\right.$ Zooecia $\left\{\begin{array}{l} Lz=0.60\text{–}0.70\text{ mm.} \\ lz=0.50\text{ mm.} \end{array}\right.$

*Variations.*—There are occasionally some zooecia bordered by a prominent thread (fig. 14). The number of small simple, peristomial avicularia is quite variable; sometimes one (fig. 15) sometimes 3 or 4 (fig. 10). The frontal walls are very thick and the tubules themselves have thick walls. In the transversal sections (fig. 9) this same phenomenon is quite visible. The tangential section (fig. 13) shows the large frontal tremopores and the black, sinuous lines of intersection with the olocyst.

*Affinities.*—This species resembles much the young zoaria of *Porella crassoparies* which surround also the small algae and their distinction is often quite difficult; it differs from the latter in the complete absence of the median avicularium.

It seems to us that this species resembles the figure given by De Gregorio of his *Eschara spongiopsis*, but we have not been able to check this observation with his type.

*Occurrence.*—Vicksburgian (Marianna limestone): One mile north of Monroeville, Alabama (very common); near Claiborne, Monroe County, Alabama (common).

Vicksburgian (Red Bluff clay): Seven and one-half miles southwest of Bladen Springs, Alabama (common).

*Plesiotypes.*—Cat. No. 64286, U.S.N.M.

### CYCLICOPORA FILIFERA, new species.

Plate 88, figs. 17–19.

*Description.*—The zoarium incrusts shells. The zooecia are large, elongated, elliptical, distinct, separated by a prominent *thread*, often quite thick; the frontal is somewhat convex and porous; it is formed of an olocyst with small scattered pores surmounting a tremocyst with larger, corresponding pores. The apertura is orbicular and placed at the base of a large, oblique peristomie; the peristome is thin, salient, sharp, bearing on its proximal border a very small avicularium; in the peristomie, there is often a very small mucro. The ovicell is hyperstomial, placed on the distal zooecium, globular, salient; it opens in the peristomie by a small orifice.

*Measurements.*—Apertura $\begin{cases} ha=0.20\text{–}0.25 \text{ mm.} \\ la=0.20 \text{ mm.} \end{cases}$ Zooecia $\begin{cases} Lz=0.85\text{–}0.95 \text{ mm.} \\ lz=0.55 \text{ mm.} \end{cases}$

*Affinities.*—We are not quite certain of the genus of this species. The tremocyst in fact, is visible only on the very well preserved zooecia; usually it does not exist and is replaced by a thick pleurocyst deposited between the threads which become very salient (fig. 18); finally there is a peristomice which does not correspond to the apertura.

In this last character, in its ovicell which opens into the peristomie, in its small peristomial avicularium this species is not without analogy with the genus *Smittina*. Perhaps it will be necessary to make a special genus but the small number of specimens collected does not permit us to do so.

*Occurrence.*—Vicksburgian (Marianna limestone): Well at depth of 140 feet, Escambia County, Alabama (very rare); near Claiborne, Monroe County, Alabama

*Cotypes.*—Cat. Nos. 64287, 64288, U.S.N.M.

### CYCLICOPORA LATICELLA, new species.

Plate 55, fig. 6.

*Description.*—The zoarium incrusts shells. The zooecia are distinct, somewhat elongated, very large, *wide*, elliptical; the frontal is convex and garnished with large tremopores scattered and funnel-shaped. The peristome is salient, complete; the apertura and the peristomice are suborbicular. On one of the sides of the zooecia there is a small elliptical avicularium somewhat straightened.

*Measurements.*—Zooecia $\begin{cases} Lz=1.00 \text{ mm.} \\ lz=0.70 \text{ mm.} \end{cases}$

*Affinities.*—The only specimen collected has been figured. It bears no ovicell. We classify it here from its apertura and its frontal. But it is evident that these characters are insufficient and that this species could also belong to the Hippopodinidae.

*Occurrence.*—Middle Jacksonian (Castle Hayne limestone): Wilmington, North Carolina (very rare).

*Holotype.*—Cat. No. 64112, U.S.N.M.

### Genus KYMELLA Canu and Bassler, 1917.

1917. *Kymella* CANU and BASSLER, Synopsis of American Early Tertiary Cheilostome Bryozoa, Bulletin 96, United States National Museum, p. 44.

The hyperstomial ovicell is always closed by the operculum. The frontal is bordered laterally by areolae. The apertura bears a very thin wide rimule.

*Genotype.*—*Kymella* (*Cyclicopora*) *polaris* Waters, 1904. Recent.

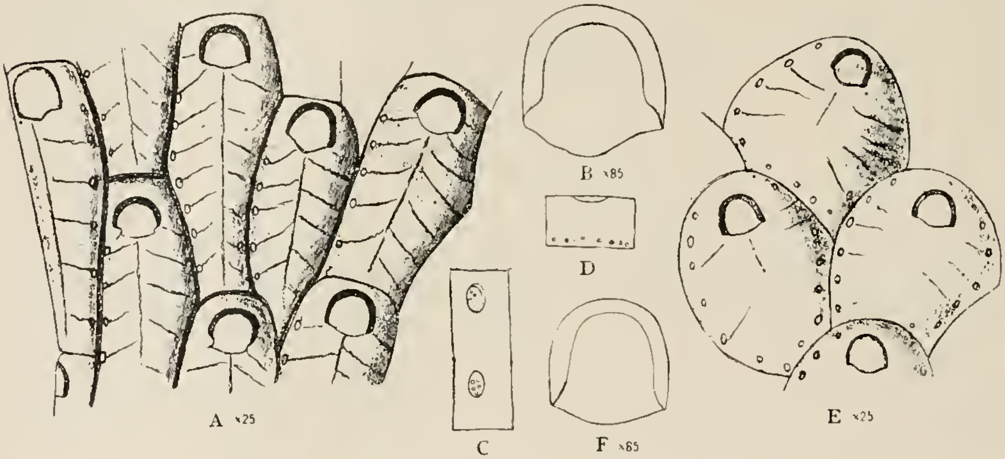


FIG. 126.—Genus *Kymella* Canu and Bassler, 1917.

A–F. *Kymella polaris* Waters, 1904. A. Zooecia of bilaminate form, × 25. B. Operculum, × 85. C. Lateral wall, showing multiporous septulae. D. Distal wall, showing uniporous septulae. E. Zooecia of adnate form, × 25. F. Operculum, × 85. (After Waters, 1904.)

### Genus AIMULOSIA Jullien, 1888.

1888. *Aimulosia* JULLIEN, Mission Scientifique du Cap Horn, vol. 6, Zoologie Bryozoaires, p. 59.

The ovicell is hyperstomial and never closed by the operculum. The apertura is semilunar; the poster is somewhat concave. The frontal is an olocyst bordered with areolae. A small round or elliptical avicularium is adjacent to the apertura.

*Genotype.*—*Aimulosia australis* Jullien, 1888.

*Range.*—Wilcoxian-Recent.

As in the genus *Exochella*, the stomach is rudimentary; it is replaced by the esophagus, which Jullien calls a gastroid esophagus.

*Lepralia pungens* Reuss, 1866, of the German Oligocene appears to belong to this genus.

### AIMULOSIA CLAVULA, new species.

Plate 9, figs. 13–16.

*Description.*—The zoarium incrusts bryozoa and shells. The zooecia are distinct, short, a little elongated; the frontal is smooth, convex, surrounded with large, triangular areolae. The apertura is semilunar with a concave poster. The ovicell is large, globular, hyperstomial; it is opened largely above the apertura.

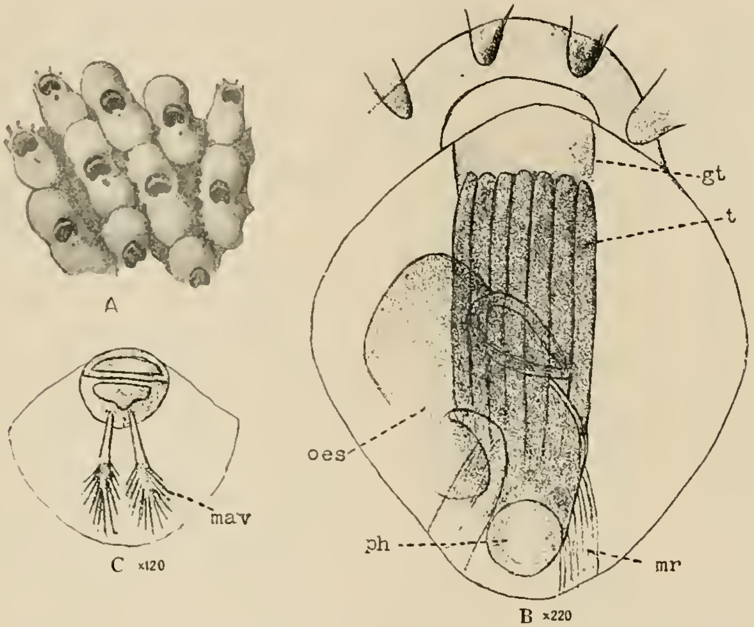


FIG. 127.—Genus *Aimulosia* Jullien, 1888.

A–C. *Aimulosia australis* Jullien, 1888. A. Zooecia, × 25. B. Polypide in place seen from the dorsal face, × 220. It is rather strange that often in the digestive apparatus of bryozoa the stomach shows as an appendage of the esophagus, and that the latter appears to replace in its abnormal volume the functions of the stomach (gastroid esophagus). C. Avicularium of the frontal face with its two muscles, × 120. (After Jullien, 1888.) *gt*, tentacular sheath; *mav*, elevator muscle of the avicularian mandible; *mr*, large retractor muscles of the polypide; *oes*, gastroid esophagus; *ph*, pharynx; *t*, tentacles.

The frontal avicularium is adjacent to the apertura; it is small, round, with pivot, and it opens externally.

*Measurements.*—Apertura $\begin{cases} ha = 0.10 \text{ mm.} \\ la = 0.12 \text{ mm.} \end{cases}$ Zooecia $\begin{cases} Lz = 0.50 \text{ mm.} \\ lz = 0.25\text{–}0.30 \text{ mm.} \end{cases}$

*Variations.*—The areolae are originally small (fig. 15); they become larger in becoming funnel shaped (fig. 13). They probably allow to pass the endocystal buds, which are developed above the frontal and which deposited an irregular pleurocyst (fig. 15). Very frequently the ovicell is wider than the zooecium, which thus assumes the form of a *nail*.

On the young zooecia (fig. 14) the ovicell is more salient and the frontal avicularium is farther removed from the apertura. Thus the variations of the pleurocyst extraordinarily deform the primitive characters.

*Occurrence.*—Wilcoxian (Bashi formation); Woods Bluff, Alabama (rare).

*Cotypes.*—Cat. No. 63855, U.S.N.M.

### Genus ANARTHROPORA Smitt, 1867.

1867. *Anarthropora* Smitt, Kritisk förteckning öfver Skandinaviens Hafsbryozoer, Öfversigt Kongl, Vetenskaps-Akademiens Förhandinglar, vol. 24, Bihang, p. 7.

"Zooecia with the oral extremity slightly produced and free, subtubular; orifice terminal, semicircular; an avicularian pore on the elevated portion of the cell in front; special pore wanting." (After Hincks, 1880.)

*Genotype.*—*Anarthropora* (*Lepralia*) *monodon* Busk. 1860.

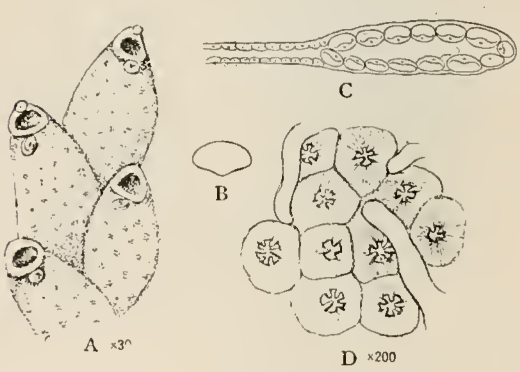


Fig. 128.—Genus *Anarthropora* Smitt, 1867.

A–D. *Anarthropora monodon* Busk, 1860. A Zooecia, × 30. (After Hincks, 1880.) B. Operculum. C. Section of tentacle, seen in profile, greatly magnified. (B, C after Jullien, 1903.) D. Stellate pores of the frontal, × 200. (After Levinsen, 1909.)

*Range.*—Latdorfian-Recent.

The anatomy was described by Jullien in 1904.

This genus, deprived of ovicell, may perhaps be better classed in the family Adeonidae.

### ANARTHROPORA (?) VERRUCOSA, new species.

Plate 7, fig. 20.

*Description.*—The zoarium incrusts bryozoa and shells. The zooecia are elongated, distinct, fusiform; the frontal is convex and *verrucose.* The aperture is semilunar; the proximal border is somewhat concave; the peristome is complete, salient, garnished with some distal spines. No ovicell. The avicularia are small, salient, simple, orbicular; there are three of them, one above the aperture and two lateral ones.

*Measurements.*—Aperture $\left\{\begin{array}{l} ha=0.06\text{–}0.07\text{ mm.}\\ la=0.06\text{ mm.}\end{array}\right.$ Zooecia $\left\{\begin{array}{l} Lz=0.35\text{–}0.40\text{ mm.}\\ lz=0.25\text{–}0.30\text{ mm.}\end{array}\right.$

*Affinities.*—The stellate pores which ornament the frontal of *Anarthropora monodon* Busk, 1860, are only visible on the young zooecia. On our specimens we have never observed them; we are not even very certain that the verrucosities observed are hollow. Nevertheless the very special arrangement of the avicularia obliges us to classify our specimens in *Anarthropora.*

*Occurrence.*—Midwayan (Clayton limestone): One mile west of Fort Gaines, Georgia (rare): Luverne, Crenshaw County, Alabama (very rare).

*Holotype.*—Cat. No. 63825, U.S.N.M.

### CYCLOCOLPOSA, new genus.

The apertura is suborbicular, or elliptical, without cardelles. The frontal is an olocyst, perforated by a double row of areolar pores and covered by a granular detachable pleurocyst. The ovicell is hyperstomial, never closed by the operculum, embedded in the distal zooecium.

*Genotype.*—*Cyclocolposa perforata*, new species.

*Range.*—Miocene-Pliocene.

In spite of appearances this genus is very different from *Cyclicopora* Hincks, 1884. The frontal pores are really areolar pores, and not tremopores, for they are separated by short costules; the granulations reveal also the detachable pleurocyst, moreover, and are often visible on the altered zooecia. In *Cyclicopora* the operculum always closes the ovicell to assure the passage of the eggs. Here this function is assured by the embedding of the ovicell in the distal zooecium, and in the great thickness of the frontal. The orifice is thus arranged in the loculla in front of the tentacular sheath.

The description of the type species is reserved for a later publication.

### CYCLOPERIELLA, new genus.

Greek: *Peri*, around. In allusion to the form of the ovicell.

The ovicell is hyperstomial, globular, not embedded in the distal zooecium, and entirely covers the apertura. The apertura is formed of a semilunar anter and of a very concave poster. The frontal is formed of a very thin olocyst supporting a tremocyst with large widened pores.

*Genotype.*—*Cycloperiella rubra*, new species.

*Range.*—Miocene-Pliocene.

This genus offers the same frontal and apertural characters as *Cyclicopora* Hincks, 1884. It differs from it in its ovicell, never closed by the operculum. The passage of the eggs is assured by the form of the ovicell itself, which entirely covers the apertura.

The type species will be described in our volume on the later Tertiary Bryozoa of North America.

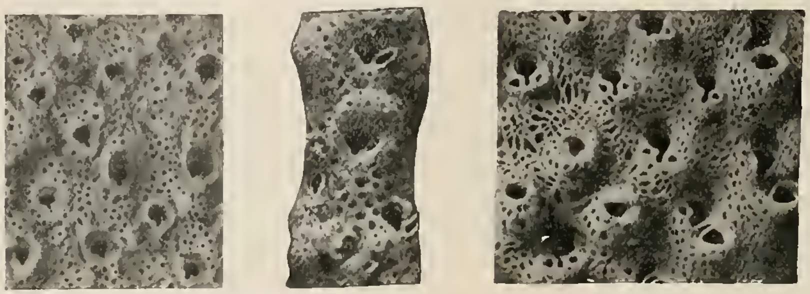
## Family STOMACHETOSELLIDAE Canu and Bassler, 1917.

The frontal is thick and occasions the formation of a peristomie. The apertura is generally orbicular or semilunar with a very concave proximal border. The peristomice is always different in form; it is notched below by a rimule-spiramen designed to conduct the water into the compensatrix. The ovicell is hyperstomial, imbedded in the distal zooecia; it opens above the apertura in the peristomie. No peristomie, lyrula, or cardelles.

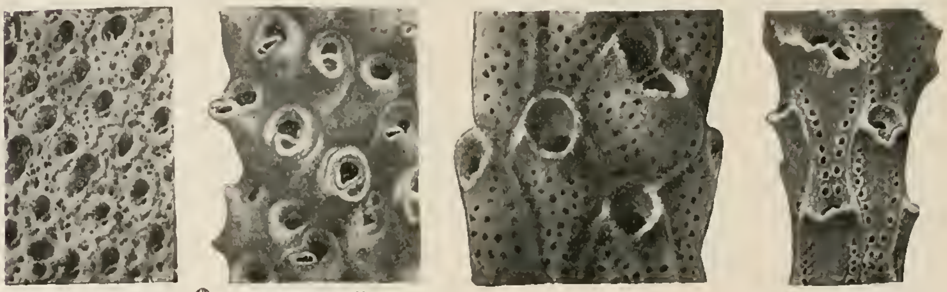
This family differs from the Reteporidae in the absence of vibices, vacuoles and reticulated zoarium, in the cleft on the ovicell and in the presence of a peristomie. It resembles this family in its imbedded ovicell and its rimule-spiramen.

It differs from the Smittinidae in the absence of lyrula, cardelles, median avicularium, and of a peristome with spines. It possesses the same imbedded ovicell opening into the peristomie. In the Smittinidae the peristomie is formed by the development of a peristome with spines; in the Stomachetosellidae it is formed by the thickening of the frontal.

We have founded our generic classification on the aspect of the ovicell and on the variations of the escape of the larvae, an important function. All the other functions, reproduction, hydrostatic, calcification, and passage of the eggs, remain exactly the same.



A. Stomachetosella B. Enoplostomella C. Metradolium



D. Schizemiella E. Leiosella F. Metrocrypta G. Ochetosella

Fig. 129.—Genera of Stomachetosellidae Canu and Bassler, 1917.

A. *Stomachetosella crassicollis* Canu and Bassler, 1917, × 20. Vicksburgian of Alabama.

B. *Enoplostomella defixa* Canu and Bassler, 1917, × 20. Vicksburgian of Alabama.

C. *Metradolium obliquum*, new species, × 20. Jacksonian of North Carolina.

D. *Schizemiella claibornica* Canu and Bassler, 1917, × 20. Claibornian of Alabama.

E. *Leiosella rostrifera* Canu and Bassler, 1917, × 20. Vicksburgian of Alabama.

F. *Metrocrypta bucculenta* Canu and Bassler, 1917, × 20. Middle Jacksonian of North Carolina.

G. *Ochetosella jacksonica* Canu and Bassler, 1917, × 20. Middle Jacksonian of North Carolina.

### Genus STOMACHETOSELLA Canu and Bassler, 1917.

1917. *Stomachetosella* Canu and Bassler. Synopsis American Early Tertiary Cheilostome Bryozoa, Bulletin 96, United States National Museum, p. 45.

The ovicell entirely surrounds the apertura. The frontal is a tremocyst with wide-mouthed tubules. No avicularia. The peristomice of the ovicelled zooecia possesses a straighter rimule-spiramen.

*Genotype.*—*Stomachetosella crassicollis* Canu and Bassler, 1917. Vicksburgian.

### STOMACHETOSELLA CRASSICOLLIS Canu and Bassler, 1917.

Plate 89, figs. 1–14.

1917. *Stomachetosella crassicollis* Canu and Bassler, Synopsis American Early Tertiary Cheilostome Bryozoa, Bulletin 96, United States National Museum, p. 45, pl. 4, fig. 7.

*Description.*—The zoarium is free, bilamellar, formed of broad, undulated branching fronds, more or less flabelliform. The zooecia are elongated, little distinct; the frontal is convex, smooth, *thick* and salient around the apertura and formed by a tremocyst with large tubules resting on a thin olocyst. The apertura (interior) is orbicular; the peristomice is provided with a triangular rimule-spiramen; the false peristome is thick and smooth. The ovicell is hyperstomial, buried, globular, salient, ornamented with tubular tremopores; it opens into the peristomie; it is possibly closed by the operculum (?); the rimule-spiramen of the ovicelled zooecia is longer and linear. Laterally, near the apertura there is often a triangular, improminent avicularium, the beak directed above, with pivot.

*Measurements.*—Peristomice (exterior) $\left\{\begin{array}{l} hpe=0.10\text{–}0.15\ \text{mm.} \\ lpe=0.15\text{–}0.20\ \text{mm.} \end{array}\right.$ Zooecia $\left\{\begin{array}{l} Lz=0.90\ \text{mm.} \\ lz=0.30\text{–}0.40\ \text{mm.} \end{array}\right.$

Apertura (interior) $\left\{\begin{array}{l} ha=0.12\text{–}0.15\ \text{mm.} \\ la=0.12\text{–}0.15\ \text{mm.} \end{array}\right.$

*Variations.*—The variations are very important and apply to all the organs. The smooth peristome is altered in the old zooecia; it loses its anterior projection (figs. 5, 6); it is not always salient (figs. 6, 7, 9). The tubules are rather constant in size (figs. 2, 3, 6, 9); they are obliterated, however, by the fossilization (fig. 8). The zooecia are sometimes separated by a prominent thread (fig. 5). The walls are very thick (figs. 12, 13, 14) and there is a special one for each zooecium (fig. 14); all the walls are united among themselves but perfectly distinct; there are no walls in common.

In the interior the apertures are orbicular; they appear elliptical and transversal in perspective because they are oblique. The wall is an olocyst with small perforations on which the tubules of the tremocyst are visible on account of its thinness.

The tangential section (fig. 10) made at the level of the olocyst shows quite well the superposition of the two secretions.

In vertical section it is easy to see that the passage of the ova is assured. It is not the same, however, for the evacuation of the larvae. However the constancy of the forms of the peristomice and ovicelled zooecia seems to indicate that the operculum could always close the ovicell; but it is necessary to suppose some very long, special opercular muscles.

This species with its enormous, solid walls, appears robust and resistant. Nevertheless this is not the case. It was rapidly exterminated and never had a large geographic distribution. This is frequent in the bryozoa where pliancy is a better sign of longevity and resistance.

*Occurrence.*—Vicksburgian (Marianna limestone): West bank of Conecuh River, Escambia County, Alabama (very common); near Claiborne, Monroe County, Alabama (rare).

*Cotypes.*—Cat. No. 62593, U.S.N.M.

### Genus ENOPLOSTOMELLA Canu and Bassler, 1917.

1917. *Enoplostomella* Canu and Bassler, Synopsis of American Early Tertiary Cheilostome Bryozoa Bulletin 96, United States National Museum, p. 46.

The apertura and peristomice of the ovicelled zooecia are identical with the apertura and with the peristomice of the ordinary zooecia. The frontal is a tremocyst with wide-mouthed tubules. The ovicell does not entirely surround the peristomice. There is an avicularium in the peristomie in the immediate vicinity of the peristomice.

*Genotype.*—*Enoplostomella defixa* Canu and Bassler. 1917.

*Range.*—Jacksonian, Vicksburgian.

#### ENOPLOSTOMELLA SYNTHETICA, new species.

Plate 90, figs. 1–9.

*Description.*—The zoarium is free, formed of from 2 to 4 lamellae, back to back, and separable. The zooecia are indistinct and irregular (exteriorly); the frontal is formed of a tremocyst with very large wide-mouthed tubules superposed on a thin olocyst perforated with small pores. The apertura (in the interior) is semilunar with a concave proximal border; the peristomie is very deep; the peristomice is orbicular, imbedded, with a wide and short rimule-spiramen limited by the peristomial avicularium. The ovicell is hyperstomial, much imbedded, little salient covered also with large tremocystal pores; it opens into the peristomie. In each peristomie there is a small triangular avicularium, little visible externally. On the frontal, laterally a small or very large avicularium is formed by the coalescence of the tubules.

*Measurements.*—Apertura (interior) $\begin{cases} ha=0.15\text{–}0.17 \text{ mm.} \\ la=0.16 \text{ mm.} \end{cases}$ Zooecia $\begin{cases} Lz=0.80\text{–}0.90 \text{ mm.} \\ lz=0.35\text{–}0.50 \text{ mm.} \end{cases}$

*Variations.*—The function and transformation of the tubules give to this species a disconcerting aspect of irregularity, augmented still more by the orientation of the zooecia, which is not constant (figs. 2, 3). The interior aspect (figs. 4, 5, 8) shows, on the contrary, a more simple organization. Through the thinness of the olocyst, perforated with small pores, the tubules regularly placed in quincunx can be seen; the frontal avicularium is visible only if it is very large.

The development of the buds of the endocyst and the result of their coalescence form here a very remarkable *synthesis*. The buds, revealed by the very similar openings of the olocyst become transformed into adventitious organs more or less complicated, which engender small simple avicularia with pivot, some avicularian cavities and large avicularia with or without pivot, in which the mandibles ought to be quite variable. The proliferation of the tubules obstructs even the apertura (fig. 7) which is nevertheless visible in the interior (fig. 8) as in *Myriozoum*.

*Affinities.*—This species differs from *Enoplostomella crassimuralis*, in its large zooecial dimensions, its external irregularity and its many layered zoarium which is never vincularoid.

*Occurrence.*—Vicksburgian (Byram marl): Byram, Mississippi (common); one-half mile west of Woodwards, Wayne County, Mississippi (very rare).

*Cotypes.*—Cat. No. 64290, U.S.N.M.

### ENOPLOSTOMELLA CRASSIMURALIS, new species.

Plate 91, figs. 1–11.

*Description.*—The zoarium is unilamellar, cylindrical, hollow; it incrusts small radicles of algae. The zooecia are little distinct, elongated, separated from each other by a *thick*, smooth projection; the frontal is thick, concave; it is formed of a tremocyst with very large tubules superposed on a very thin olocyst with minute pores. The apertura (in the interior) is formed of a semilunar anter and of a concave poster; it is transverse and oblique; the peristomice is triangular, buried; the rimule-spiramen is wide and bordered laterally by the peristomial avicularium. The avicularium is adjacent to the peristomice; it is triangular provided with a pivot and its beak is directed toward the top.

*Measurements.*—Apertura (interior) $\left\{\begin{array}{l} ha=0.12 \text{ mm.} \\ la=0.16 \text{ mm.} \end{array}\right.$ Peristomice (exterior) $\left\{\begin{array}{l} hpe=0.20 \text{ mm.} \\ lpe=0.20 \text{ mm.} \end{array}\right.$

Zooecia $\left\{\begin{array}{l} Lz=0.70\text{–}0.75 \text{ mm.} \\ lz=0.32\text{–}0.45 \text{ mm.} \end{array}\right.$

*Variations.*—On account of the thickness of the walls, the variations of the frontal are extraordinary (figs. 2–5); the exterior aspect does not correspond at all with the view of the interior (figs. 6, 7) which is fortunately more regular. The zooecia have no special walls (figs. 8, 10); they are invisible in thin sections: an energetic consolidation must take place on the very young zooecia; the latter moreover do not bear any kind of prominent separating mural rim. The tubules are seen with difficulty on the transverse sections (figs. 9, 10).

In the interior the avicularium appears as a triangular chamber adjacent to the apertura. The olocyst is very thin; the tubules are visible as round white spots by transparency. Their pores are all very small (figs. 6, 7); this is the reason that in tangential sections the tremopores are large, round, and obscure spots feebly lighted by a luminous point.

The zoarium is formed sometimes by two superposed lamellae. Very rarely it is bifurcated.

*Affinities.*—In the external aspect of the zoarium, this species resembles *Enoplostomella rhomboidalis*, but it differs from it in its hollow zoarium and the much thicker, separating mural rim.

*Occurrence.*—Vicksburgian (Marianna limestone): Salt Mountain, 5 miles south of Jackson, Alabama (very rare); near Claiborne, Monroe County, Alabama (rare); deep well in Escambia County, Alabama (very rare).

*Cotypes.*—Cat. No. 64293, U.S.N.M.

### ENOPLOSTOMELLA RHOMBOIDALIS, new species.

Plate 90, figs. 10–16.

*Description.*—The zoarium is free, cylindrical, or somewhat compressed, bifurcated, formed of two lamellae, back to back, and inseparable. The zooecia are little distinct, elongated, *rhomboidal*, separated by a prominent thread; the frontal is somewhat convex and formed by a thick tremocyst with very large tubules resting on a thin olocyst irregularly perforated. The apertura is very oblique, semilunar, with a proximally concave border; the peristomice is elongated, much buried, with a triangular rimule-spiramen. The ovicell is hyperstomial, opening into the peristomie, little salient, globular, ornamented with large tremopores. In the peristomie there is a small triangular avicularium with pivot, placed transversely.

*Measurements.*—Peristomice (exterior) $\begin{cases} hpe = 0.16 \text{ mm} \\ lpe = 0.12 \text{ mm.} \end{cases}$ Zooecia $\begin{cases} Lz = 0.65\text{–}0.75 \text{ mm.} \\ lz = 0.45\text{–}0.60 \text{ mm.} \end{cases}$

*Variations.*—The thread separating the zooecia is quite variable and changes the external aspect considerably; it is thickened laterally (fig. 12) or only near the apertura (fig. 14). It gives to the zooecia a greater width (fig. 13) or less (fig. 15).

In the interior, the structure is more regular, but it may be noted that the small perforations of the olocyst are not regularly arranged in quincunx, an occurrence which is very rare.

*Affinities.*—This species differs from *Enoplostomella crassimuralis*, in which the zoarium has some resemblance, in its rhomboidal form, its solid and not hollow zoarium and its peristomice still more imbedded.

It differs from *Enoplostomella defixa*, also with a cylindrical zoarium, in its smaller and more hidden peristomial avicularium, its much less salient ovicell and in its less zooecial width.

*Occurrence.*—Vicksburgian (Marianna limestone): One mile north of Monroeville, Alabama (rare); 2½ miles north of Millry, Washington County, Alabama (rare).

*Cotypes.*—Cat. No. 64291, U.S.N.M.

### ENOPLOSTOMELLA DEFIXA Canu and Bassler, 1917.

Plate 91, figs. 12–21.

1917. *Enoplostomella defixa* CANU and BASSLER, Synopsis of American Early Tertiary Cheilostome Bryozoa, Bulletin 96, United States National Museum, p. 46, pl. 4, fig. 8.

*Description.*—The zoarium is free, cylindrical, vinculariform, formed of six to seven longitudinal rows of zooecia. The zooecia are indistinct; the frontal is little thickened, convex, formed of a tremocyst with large pores placed above an olocyst with tubules. The apertura (interior) is formed of a semilunar anter and of a concave poster; the peristomice (exterior) is elongated, *imbedded*, provided with a triangular rimule-spiramen. The ovicell is hyperstomial, buried in the distal zooecia, globular, salient, decorated with large tremopores; it opens largely into the peristomie. The oral avicularium is adjacent to the peristomice and placed somewhat obliquely; it is triangular, rather long, and provided with a pivot; the beak is turned outward.

*Measurements.*—Apertura (interior) $\begin{cases} ha=0.15 \text{ mm.} \\ la=0.15 \text{ mm.} \end{cases}$ Peristomice $\begin{cases} hpe=0.14\text{–}0.16 \text{ mm.} \\ lpe=0.18\text{–}0.20 \text{ mm.} \end{cases}$

Zooecia $\begin{cases} Lz=0.90\text{–}1.00 \text{ mm.} \\ lz=0.40 \text{ mm.} \end{cases}$

*Variations.*—The zooecial walls are relatively little thickened (figs. 19, 20, 21); also the exterior aspect is rather constant. The variations observed are principally those of the avicularium; it is often long and salient (figs. 14, 15), often short (fig. 13), often worn (figs. 17, 18). The tremopores are large, but they are smaller when they are more numerous (figs. 16, 18). The zooecia are sometimes bordered by a thread (fig. 14) which may become very prominent.

The tangential section shows the frontal tremopores. Because of the general convexity of the zoarium it is impossible to obtain a preparation which shows all of them. In figure 21 the lateral tremopores occur alone and in the middle, the subjacent olocyst appears.

*Affinities.*—This species differs from *Enoplostomella rhomboidalis*, in its zoarial form, in the absence of large separating threads between the zooecia, and in the much more globular ovicell.

It differs from *Enoplostomella ligulifera*, which is also vinculariform in the absence of lateral tongues to the peristomice and in its oral avicularium of much less strength. ($Lav=0.25$ mm. and not 0.40 mm.)

*Occurrence.*—Vicksburgian ("Chimney rock" of Marianna limestone): One mile north of Monroeville, Alabama (very common).

*Cotypes.*—Cat. No. 62594, U.S.N.M.

### ENOPLOSTOMELLA LIGULIFERA, new species.

Plate 90, figs. 17–22.

*Description.*—The zoarium is free, cylindrical, sometimes bifurcated. The zooecia are distinct, elongated, fusiform; the frontal is convex, thick, formed of a tremocyst with tubules surmounting a thin olocyst with small scattered pores. The apertura is very oblique and orbicular; the peristomice is large, elongated, provided with a wide, triangular, short rimule-spiramen, garnished laterally with two salient, widespread *tongues*. The ovicell is hyperstomial, globular, salient, garnished with tremopores; it opens largely into the peristomie. The avicularium is very long, transversal, provided with a pivot; the beak is directed outward.

*Measurements.*—Apertura (interior) $\begin{cases} ha=0.15 \text{ mm.} \\ la=0.15 \text{ mm.} \end{cases}$ Peristomice (exterior) $\begin{cases} hpe=0.20 \text{ mm.} \\ lpe=0.15 \text{ mm.} \end{cases}$

Zooecia $\begin{cases} Lz=0.75\text{–}0.85 \text{ mm.} \\ lz=0.45 \text{ mm.} \end{cases}$

*Variations.*—The peristomice is somewhat round with the avicularium adjacent. When the rimule-spiramen is much developed. there are no avicularia. The two occurrences may be observed on the same zoarial fragment. The lateral tongues are quite variable in form and size.

*Affinities.*—This species differs from *Enoplostomella defixa* in its very long avicularium (0.40 and not 0.25 mm.) and in the tongue-like processes of the peristomice.

It differs from *Enoplostomella rhomboidalis* in its zooecia separated by furrows and not by prominences, and in its much more globular and salient ovicells.

*Occurrence.*—Vicksburgian (Red Bluff clay): Seven and one-half miles southwest of Bladon Springs, Alabama (very common).

*Cotypes.*—Cat. No. 64292, U.S.N.M.

## ENOPLOSTOMELLA VALLATA, new species.

Plate 92, figs. 1–10.

*Description.*—The zoarium is free, bifurcated, compressed, formed of three or four longitudinal rows of zooecia arranged on one side; on the dorsal face the zooecia are separated by projections or *stockades* and ornamented with tremopores. The zooecia are elongated, rectangular, separated by projections; the frontal is convex, thick, formed of a tremocyst with tubules surmounting a perforated olocyst. The apertura is very oblique and semilunar with a straight proximal border; the peristomice is somewhat elongated and is provided with a wide and triangular rimule-spiramen. The avicularium is placed on the border itself of the rimule-spiramen, which it bounds laterally; it is triangular and provided with a pivot; the beak is turned outward.

*Measurements.*—Apertura (interior) $\begin{cases} ha=0.12 \text{ mm.} \\ la=0.15 \text{ mm.} \end{cases}$ Peristomice $\begin{cases} hpe=0.20 \text{ mm.} \\ lpe=0.18 \text{ mm.} \end{cases}$

Zooecia $\begin{cases} Lz=0.85\text{–}0.95 \text{ mm.} \\ lz=0.45 \text{ mm.} \end{cases}$

Width of branches=0.85–1.00 mm.

*Variations.*—The projections which bound the zooecia on the two faces of the zoarium are not constant; certain branches are deprived of them (figs. 5, 6). However, on the dorsal face, the two lateral rows are alone visible; on account of their alternate arrangement they appear irregular on the transverse section (figs. 7, 8) and only one may be visible (fig. 9). The tubules are longer on the dorsal of the zoarium (fig. 10). We have never been able to discover the ovicell on any of our numerous specimens.

*Affinities.*—This species is not vinculariform, as are the other species of the same genus previously described. The zooecia are arranged on but one side of the zoarium. We do not think that it would be of any advantage to create a special genus for this particular arrangement as the functions are exactly the same as those of the other *Enoplostomella*. We can not logically separate it without a complete study of the ovicell.

The species differ from *Enoplostomella magniporosa* in its much smaller tremopores, and its less wide zooecia.

*Occurrence.*—Vicksburgian (Marianna limestone): West bank of the Conecuh River, Escambia County, Alabama (very common); Murder Creek, east of Castlebury, Conecuh County, Alabama (very common).

*Cotypes.*—Cat. No. 64295, U.S.N.M.

### ENOPLOSTOMELLA MAGNIPOROSA, new species.

Plate 89, figs. 15–20.

*Description.*—The zoarium is free, bifurcated, compressed, formed of four longitudinal rows of zooecia arranged on one side only; on the dorsal face the zooecia are separated by projections and ornamented with large tremopores. The zooecia are distinct, elongated, hexagonal; the frontal is flat or convex and formed of a tremocyst with very *large pores*. The apertura is suborbicular; the peristomice is elongated and is provided with a wide and rounded rimule-spiramen. The ovicell is hyperstomial, small, salient, ornamented with tremopores. The avicularium is placed almost within the peristomie; it is oval, provided with a pivot; the beak is directed outward.

*Measurements.*—Peristomice (exterior) $\begin{cases} hpe=0.20 \text{ mm.} \\ lpe=0.18 \text{ mm.} \end{cases}$ Zooecia $\begin{cases} Lz=0.75 \text{ mm.} \\ lz=0.55 \text{ mm.} \end{cases}$

*Variations.*—On the young branches (fig. 19) the avicularium is not placed in the peristomie and the zooecia are more convex and are separated by furrows. We have found only the single ovicell figured, and on a young branch (fig. 19). The tremopores, by their coalescence, give to certain zooecia a fantastic aspect (fig. 16).

*Affinities.*—The zoarium has the aspect of that of *Enoplostomella vallata;* it differs from it in the size of its tremopores and in its avicularium placed within the peristomie.

*Occurrence.*—Vicksburgian (Byram marl): Byram, Mississippi (common).

*Cotypes.*—Cat. No. 64289, U.S.N.M.

## Genus SCHIZEMIELLA Canu and Bassler, 1917.

1917. *Schizemiella* CANU and BASSLER, Synopsis American Early Tertiary Cheilostome Bryozoa, Bulletin 96, United States National Museum, p. 47.

The frontal of the ovicell is very fragile. The apertura is schizoporellidan with wide rimule. The rimule-spiramen is inconstant. The tubules are reunited on their commonage.

*Genotype.*—*Schizemiella claibornica* Canu and Bassler, 1917. Claibornian.

### SCHIZEMIELLA CLAIBORNICA Canu and Bassler, 1917.

Plate 14, figs. 2–4.

1917. *Schizemiella claibornica* Canu and Bassler, Synopsis American Early Tertiary Cheilostome Bryozoa, Bulletin 96, United States National Museum, p. 47, pl. 4, fig. 9.

*Description.*—The zoarium is free, bilamellar, with inseparable lamellae. The zooecia are indistinct; the frontal is thickened, little convex, formed of a tremocyst with large, irregular tubules placed on a thin olocyst with very small pores in quincunx. The apertura is formed of an ogival anter and a concave poster with a very wide rimule; the peristomice is elongated, embedded, with a very wide, irregular rimule-spiramen. The ovicell is hyperstomial and opens largely into the peristomie; it is little globular, hardly salient; covered by a smooth or perforated, very fragile wall; the peristomice is elliptical and transverse. The avicularium is triangular, the point directed above, adjacent to the peristomice which it deforms, provided with a pivot.

*Measurements.*—Peristomice (exterior) $\begin{cases} hpe=0.20 \text{ mm.} \\ lpe=0.14\text{–}0.16 \text{ mm.} \end{cases}$ Apertura (interior) $\begin{cases} ha=0.12 \text{ mm.} \\ la=0.11 \text{ mm.} \end{cases}$

Zooecia (interior) $\begin{cases} Lz=0.54 \text{ mm.} \\ lz=0.30 \text{ mm.} \end{cases}$

*Variations.*—In the interior the tremopores are regularly placed in quincunx; on the exterior they are very irregularly disposed, larger and less numerous.

The frontal of the ovicell is so fragile that we are unable to get an exact idea of it from our few specimens. This organ requires further examination.

The rimule of the peristomice is very irregular. In reality the form of the apertura belongs (fig. 4) to the group of very typical *Schizoporella*, and the operculum ought to be chitinized enough to sufficiently insure the opening of the compensatrix by itself.

*Occurrence.*—Claibornian (Gosport sand): Claiborne, Alabama (rare); 1 mile southwest of Rockville, Clarke County, Alabama (rare); Gopher Hill, Tombigbee River, Alabama (rare).

Claibornian (Cook Mountain formation): Moseleys Ferry, Caldwell County, Texas (rare).

*Cotypes.*—Cat. No. 62595, U.S.N.M.

### Genus METRADOLIUM Canu and Bassler, 1917.

1917. *Metradolium* Canu and Bassler, Synopsis American Early Tertiary Cheilostome Bryozoa, Bulletin 96, United States National Museum, p. 47.

The ovicelled zooecia, different in form from the others, have a peristomice in the form of a lunar crescent without rimule-spiramen. The frontal is a tremocyst with tubules.

*Genotype.*—*Metradolium dissimile* Canu and Bassler, 1917. Jacksonian.

*Eschara tuberosa* Reuss, 1866, of the Stampian of Germany, belongs without doubt to this genus.

The ovicells have the aspect of the gonoecia of the Adeonidae. Employing sections it may be seen (pl. 57, fig. 10) that this aspect is deceptive and that the ovicells are hyperstomial and open in the peristomie; only the form of the peristomice is changed. This change is in certain relationship with the physiologic peculiarity which is difficult of analysis and of precise description. We believe that the ovicelled zooecia exist only for the larva. After the passage of the eggs, the polypide and the compensatrix disappear by histolysis, so that the peristomice lunar-crescent in shape, serves only for the escape of the larvae. It is, in fact. very difficult to suppose the persistence of a polypide, in the absence of hydrostatic apparatus (rimule) and in a peristomial system so long and so complicated. Moreover, these same zooecia are provided with a much reduced avicularium; this organ was useful in nutrition; its reduction proves its inutility and consequently the disappearance of the polypide. There is nothing analogous in the recent species.

The species of this genus are quite polymorphic. Their classification has required much time, much patience, and much trouble. The alterations due to fossilization often occasion problems difficult of solution.

The individuals were very voracious; they therefore did not persist in the successive stages of a region.

These ovicells are not without analogy with those of the Tubucellariidae (text fig. 159 E) and the histological phenomena ought to be somewhat analogous. The Tubucellariidae are always provided with an ascopore and not with a spiramen, that is to say, a pore which opens into the compensatrix itself and not into a peristomie.

### METRADOLIUM LABRATULUM, new species.

Plate 55, figs. 8–11.

*Description.*—The zoarium is free, bilamellar, with rounded and bifurcated fronds. The zooecia are little distinct, elongated, elliptical; the frontal is a tremocyst with tubules placed on a very thin olocyst in which very thin perforations correspond to the tubules. The apertura (interior) is orbicular; the peristomice bears a rimule-spiramen on the zooecia with an oral avicularium; the peristomice is orbicular on the zooecia provided with an enormous proximal mucro at the base of which is the spiramen. The avicularium is very much projecting, oval, furnished with a pivot; its beak is directed toward the exterior.

*Measurements.*—Peristomice $lpe=0.16–0.20$ mm. Zooecia $\begin{cases} Lz=0.60–1.00 \text{ mm.} \\ lz=0.30–0.40 \text{ mm.} \end{cases}$

*Variations.*—This species is curious and instructive. On the same zoarium we may note the existence of a rimule and of a spiramen, both of which must have the same function, namely, of conducting the water below the apertura to sway the operculum and to open the compensatrix. One must not confound this spiramen with the ascopore of the Microporellae; the latter is the same opening as that of the compensatrix.

Here the large oral mucro replaces exactly the avicularium; it therefore has the same nutritive use. This is why in many mucronated species we see the mucro much elongated in the buried parts of the zoarium. This species then permits us, according to Calvet, to determine the physiologic equivalence of the two organs.

The size of the avicularian mandible indicates a voracious species, which did not live long.

The mucro is quite variable in form and it is sometimes a sort of very irregular salient *lip*.

*Occurrence.*—Middle Jacksonian: One-half mile southeast of Georgia Kaolin Co. Mine, Twiggs County, Georgia (rare); 3½ miles north of Grovania, Georgia (rare); Baldock, Barnwell County, South Carolina (rare); 18 miles west of Wrightsville, Johnson County, Georgia (very rare); 1½ miles southeast of Lily, Dooly County, Georgia (rare).

Jacksonian (Zeuglodon beds): Shubuta, Mississippi (rare).

*Cotypes.*—Cat. No. 64114, U.S.N.M.

### METRADOLIUM DISSIMILE Canu and Bassler, 1917.

Plate 56, figs. 1–15.

1917. *Metradolium dissimile* Canu and Bassler, Synopsis American Early Tertiary Cheilostome Bryozoa, Bulletin 96, United States National Museum, p. 48, pl. 4, fig. 10.

*Description.*—The zoarium is free, bilamellar, branching; the fronds are wide, thick, distorted, or undulated, dichotomous. The zooecia are distinct, elongated, elliptical. The frontal is a tremocyst with tubules resting on an olocyst with very small pores corresponding to the tubules. The peristomie is deep and very oblique; the apertura is small and suborbicular; the peristomice is orbicular; the spiramen is median, more or less distant from the peristomice. There are two oral avicularia symmetrically placed but *dissimilar* in form and size; the smaller is round, simple, nonsalient; the larger is enormous, oval, salient, with pivot. The ovicell is enormous, buried in the distal zooecia, hyperstomial but opening largely into the peristomie, salient and globular; its peristomice has the form of a lunar crescent; the ovicelled zooecia bear only a small avicularium with pivot.

*Measurements.*—Peristomice (exterior) $\left\{\begin{array}{l} hpe=0.14\text{–}0.16\text{ mm.}\\ lpe=0.15\text{–}0.20\text{ mm.}\end{array}\right.$ Zooecia (exterior) $\left\{\begin{array}{l} Lz=0.74\text{–}0.76\text{ mm.}\\ lz=0.40\text{–}0.50\text{ mm.}\end{array}\right.$

*Variations.*—The two avicularia are often symmetrical and tubular (fig. 9), especially on young zoaria (figs. 10, 11); there are some entire branches constituted in this way, but presenting here and there some normal avicularia. The external micrometric dimensions are evidently smaller on the young zoaria (figs. 10, 11); the more the frontal becomes thickened the more the peristomice becomes greater and the more robust the large avicularia become.

The spiramen is often replaced by a rimule-spiramen (fig. 7), a phenomenon visible in the interior (fig. 12) on account of the great obliquity of the peristomie. When the spiramen is quite large (figs. 2, 3), the oral avicularia disappear or are much reduced; the fronds with this structure do not belong to a distinct variety for it is a common occurrence to find fronds containing a mixture of such zooecia and normal zooecia.

The ovicell is globular, salient, with tremopores analogous to those of the frontal (fig. 5); the zooecia which bear them have also an avicularium and a spiramen, but the latter invariably becomes closed and it does not appear in vertical sections (fig. 15). The ovicell is enormous, almost as large as the zooecia (fig. 15). If it contains only larvae, as is probable, their expulsion through a peristomice so small would present some difficulty.

Tangential sections (figs. 13, 14) show numerous tremopores; the reticulations are not visible on account of the distance of the olocyst.

*Affinities.*—This species differs from *Metradolium labratulum* in the absence of the large oral labrum.

It differs from *Metradolium parvirimulatum* in the rarity of the zooecia with rimule-spiramen, in the much smaller dimensions of the peristomice (0.12 instead of 0.14 mm.), and in the constant presence of the large oral avicularium.

*Occurrence.*—Middle Jacksonian: Wilmington, North Carolina (very common); Eutaw Springs, South Carolina (rare); near Lenuds Ferry, South Carolina (common); Rich Hill, Crawford County, Georgia (common); 12 miles southeast of Marshallville, Georgia (rare); 3¼ miles south of Perry, Georgia (very common).

*Cotypes.*—Cat. No. 62596, U.S.N.M.

### METRADOLIUM PARVIRIMULATUM, new species.

Plate 55, figs. 15–20.

*Description.*—The zoarium is free, compressed, bilamellar; the fronds are flat, narrow, bifurcated; the lamellae are inseparable. The zooecia are little distinct; the frontal is convex, thick, formed of a tremocyst with numerous tubules. The apertura (interior) is semilunar; the peristomice is small, transverse; it bears a small unsymmetrical rimule-spiramen, one side being higher than the other; the peristomice of the zooecia with spiramen is wide, elliptical, transverse. There are two symmetrical, oral avicularia, of which one is much larger than the other; the latter is salient, elliptical, the beak turned toward the exterior.

*Measurements.*—Peristomice (exterior) $\}lpe=0.12$ mm. Zooecia $Lz=0.56–0.60$ mm.

*Variations.*—The principal avicularium is very small (fig. 17), medium sized or very large (fig. 19). The zooecia with spiramen are rare; they are arranged in groups in the midst of the others. We are unable to learn what influence causes their formation. The ovicell is unknown.

*Affinities.*—This species differs from *Metradolium dissimile* in the rarity of its zooecia with spiramen and its much smaller micrometric dimensions ($lz=0.56–0.60$ and not 0.74–0.76 mm.).

The specimens unprovided with zooecia with spiramen are difficult to distinguish from *Metradolium obliquum*. It differs from it in its smaller micrometric dimensions ($lz=0.56–0.60$ and not 0.70–0.80 mm.), in its much smaller rimule, nearly symmetrical and not oblique.

*Occurrence.*—Middle Jacksonian: Wilmington, North Carolina (rare); near Lenuds Ferry, South Carolina (common); Eutaw Springs, South Carolina (very common); Rich Hill, Crawford County, Georgia (common); Baldock, Barnwell County, South Carolina (common); one-half mile southeast of Georgia Kaolin Company Mine, Twiggs County, Georgia (common).

Upper Jacksonian (Ocala limestone): Alachua, Florida (very rare); west bank of Sepulga River, Escambia County, Alabama (very rare).

*Cotypes.*—Cat. No. 64118, U.S.N.M.

### METRADOLIUM TRANSVERSUM, new species.

Plate 57, figs. 1–3.

*Description.*—The zoarium is free, bilamellar, erect; the fronds are foliaceous or nearly cylindrical; the two lamellae, back to back, are inseparable. The zooecia are indistinct, elongated, and large; the frontal is convex, thick, and formed of a tremocyst resting on an olocyst, with small corresponding pores in quincunx. The aperture is elongated, semilunar, with a concave proximal border; the peristomice is oblique, wide, *transverse;* the rimule-spiramen is wide but little deep; its form and its position are irregular. The oral avicularium is small, rare, and inconstant.

*Measurements.*—Apertura (interior) $\left\{\begin{array}{l} ha=0.20 \text{ mm.} \\ la=0.17 \text{ mm.} \end{array}\right.$ Zooecia $\left\{\begin{array}{l} Lz=0.80 \text{ mm.} \\ lz=0.40 \text{ mm.} \end{array}\right.$

Peristomice (exterior) $\left\{\begin{array}{l} hpe=0.15 \text{ mm.} \\ lpe=0.18\text{–}0.20 \text{ mm.} \end{array}\right.$

*Variations.*—On well-preserved specimens the tremopores are placed at the bottom of small sulci. These tremopores are small, numerous, regularly arranged in quincunx; they are easily altered by fossilization. The peristomice is very irregular; the rimule is often placed quite laterally (fig. 2), and it is replaced on the proximal border by a salient convexity, which augments still more the transverse aspect of the peristomice. In old zooecia the rimule disappears, the peristomice becomes orbicular and deep; the species is then unrecognizable.

*Affinities.*—This species differs from *Metradolium parvirimulatum* in the inconstance of its rimule-spiramen, its large micrometric dimensions ($Lz=0.80$ and not 0.60 mm.), and in the absence of zooecia with spiramen. It differs from *Metradolium grande* in its much smaller rimule, its smaller peristomice ($lpe=0.20$ and not 0.25 mm.), and its more numerous and smaller tremopores.

It differs from *Metradolium sulciferum* in its less deep and more transitory sulci, in its very small rimule-spiramen, and the absence of the large oral avicularium.

*Occurrence.*—Middle Jacksonian (Castle Hayne limestone): Wilmington, North Carolina (very common).

Upper Jacksonian (Ocala limestone): Chipola River, east of Marianna, Jackson County, Florida (common).

Jacksonian (Zeuglodon zone): Shubuta, Mississippi (very rare).

*Cotypes.*—Cat. No. 64120, U.S.N.M.

### METRADOLIUM GRANDE, new species.

Plate 55, figs. 12–14.

*Description.*—The zoarium is free, bilamellar, erect; the fronds are dichotomous, foliaceous or subcylindrical; the two lamellae are inseparable. The zooecia are very *large*, elongated, indistinct laterally; the frontal is convex, thick, formed of a tremocyst with large pores. The peristomice is large, elongated; the rimule-spiramen is large, rounded. The oral avicularium is large, transverse adjacent to the peristomice or placed in the peristomie.

*Measurements.*—Peristomice (exterior) $\begin{cases} hpe=0.35\text{–}0.45\text{ mm.} \\ lpe=0.25\text{–}0.40\text{ mm.} \end{cases}$ Zooecia $\begin{cases} Lz=0.90\text{–}1.00\text{ mm.} \\ lz=0.50\text{ mm.} \end{cases}$

*Affinities.*—When the avicularium is exterior the rimule-spiramen is quite well formed (fig. 13); when it is hidden in the peristomie the rimule becomes very irregular and deeper. It is the lengthening of the tubules of the tremocyst which increase and deform the peristomice and augment the external dimensions of the zooecia.

This species differs from *Metradolium transversum* in its large rimule, its elongated and nontransverse peristomice ($hpe=0.35$ and not 0.15 mm.) and its large tremopores.

It differs from *Metradolium sulciferum* in the absence of frontal sulci and its smaller general micrometric dimensions.

*Occurrence.*—Middle Jacksonian: Near Lenuds Ferry, South Carolina (very rare); Rich Hill, Crawford County, Georgia (rare); Eutaw Springs, South Carolina (rare); one-half mile southeast of Georgia Kaolin Company Mine, Twiggs County, Georgia (rare).

Jacksonian (Zeuglodon zone): Bluff on south side of Suck Creek, Clarke County, Mississippi (very rare).

*Cotypes.*—Cat. Nos. 64116, 64117, U.S.N.M.

### METRADOLIUM CONVENIENS, new species.

Plate 56, figs. 16–21.

*Description.*—The zoarium is free, bilamellar, erect; the fronds are foliaceous, flat, or undulated, branching; the two lamellae, back to back, are inseparable. The zooecia are elongated, little distinct laterally; the frontal is convex, thick; it is formed of a tremocyst with small tubules arranged in quincunx, placed on a very thin olocyst with small corresponding pores. The apertura is subround; the peristomice is very elongated, elliptical; the rimule-spiramen is more or less visible and always *symmetrical.* The ovicell is globular, little salient, ornamented with tremopores similar to those of the frontal; its peristome is transverse in the form of a lunar-crescent; it is hyperstomial, very large, and opens largely into the peristomie. Near the peristomice there are two elliptical avicularia, replaced often by a single larger and more salient one.

*Measurements.*—Apertura (interior) $\begin{cases} ha=0.11 \text{ mm.} \\ la=0.11 \text{ mm.} \end{cases}$ Peristomice (interior) $\begin{cases} hpe=0.18 \text{ mm.} \\ lpe=0.12 \text{ mm.} \end{cases}$

Zooecia $\begin{cases} Lz=0.50\text{–}0.60 \text{ mm.} \\ lz=0.30\text{–}0.40 \text{ mm.} \end{cases}$

*Variations.*—The peristomice is quite variable in its general form; it is often provided with a rimule-spiramen (figs. 17, 18), but there are some entire fronds which are entirely without it (fig. 20). The ovicells are quite variable in form and size (figs. 17–19). The two oral avicularia are symmetrical (fig. 20), but very often there is only one large oval avicularium with pivot, having its beak turned outward (fig. 19).

The longitudinal section (fig. 21) shows that the ovicell is almost as large as the zooecium itself, and that the apertura of the ovicelled zooecium is smaller than that of the other zooecia.

*Affinities.*—The symmetry of the rimule-spiramen is very characteristic and permits one to easily distinguish this species.

It differs from *Metradolium grande*, in which the rimule-spiramen is often symmetrical, in its smaller micrometric dimensions ($Lz$=0.60 and not 0.90 mm.) and its smaller and more numerous tremopores.

It differs from *Metradolium dissimile*, in which the rimule-spiramen is vaguely symmetrical, in the absence of zooecia with spiramen, and in the somewhat smaller dimensions ($Lz$=0.60 and not 0.76 mm.).

*Occurrence.*—Middle Jacksonian (Castle Hayne limestone): Wilmington, North Carolina (very common).

*Cotypes.*—Cat. No. 64119, U.S.N.M.

### METRADOLIUM OBLIQUUM, new species.

Plate 57, figs. 4–10.

*Description.*—The zoarium is free, bilamellar, erect; the fronds are flat, bifurcated; the two lamellae are back to back and inseparable. The zooecia are elongated, very little distinct; the frontal is thick, convex; it is formed of a tremocyst with tubules surmounting an olocyst, which is very thin and finely perforated with corresponding pores. The apertura is oblique, suborbicular; the peristomice is formed of a subcircular anter with poorly defined outlines and of an unsymmetrical rimule-spiramen *oblique* with respect to the zooecial axis. The ovicell is globular, salient, hyperstomial, largely open into the peristomie, deeply embedded in the distal zooecium; it is covered with tremopores like the frontal; the peristomice is large, transverse, in the form of a lunar crescent, of which the convexity is proximal. Two avicularia are symmetrically placed on each side of the rimule; the larger is salient, transverse, oval, provided with a pivot, its beak turned outward.

*Measurements.*—Apertura (interior) $\}$ $la$=0.15 mm. Peristomice (exterior) $\}$ $lpe$=0.15 mm.

Zooecium $\begin{cases} Lz=0.70\text{–}0.80 \text{ mm.} \\ lz=0.40\text{–}0.50 \text{ mm.} \end{cases}$

*Variations.*—The rimule-spiramen is unsymmetrical and oblique; it is formed of two lateral lips not arranged on the same plane; one is always higher than the other; the lower is always adjacent to the large avicularium. When the two oral avicularia are symmetrical the rimule is symmetrical. There is, therefore, a certain relation between the functions of the avicularia and the hydrostatic system. The longitudinal section shows a very large ovicell opening into the peristomie above the operculum, and a large septula (multiporous) at the base of the zooecia (fig. 10).

The tangential section (fig. 8) shows the structure of the frontal, which is a tremocyst with tubules. The convexity of the zooecia allows one to note the subjacent olocyst at the edge of the tremocyst (fig. 9).

*Affinities.*—In the interior the apertura bears a proximal spine forming a sort of lyrula (fig. 7) which disappears easily in fossilization. This species differs from *Metradolium sulciferum* in its smaller tremopores not arranged at the base of the sulci.

It differs from *Metradolium dissimile* in the general absence of zooecia with a spiramen and in the lesser width of the peristomice ($lpe$=0.15 and not 0.20 mm.).

*Occurrence.*—Middle Jacksonian: Wilmington, North Carolina (very common); 3½ miles north of Grovania, Georgia (rare); 12 miles southeast of Marshallville, Georgia (common); Rich Hill, Crawford County, Georgia (very common); 18 miles west of Wrightsville, Georgia (rare); 3½ miles south of Perry, Georgia (common); near Lenuds Ferry, South Carolina (very common).

*Cotypes.*—Cat. No. 64121, U.S.N.M.

### METRADOLIUM SULCIFERUM, new species.

Plate 14, figs. 5–15.

*Description.*—The zoarium is free, bilamellar, erect; the fronds are compressed, narrow, bifurcated. The zooecia are large, elongated, indistinct; the frontal is convex, thick, formed of a tremocyst with tubules, supported by a very thin olocyst, finely perforated with corresponding pores and closely joined. The apertura is formed of a semilunar anter and of a concave poster supporting a very short median lyrula; the peristomice is oblique and is formed of an anter with undefined outlines and an unsymmetrical rimule-spiramen. There are two avicularia symmetrically placed on each side of the rimule; the larger is provided with a pivot and with a very large mandible.

*Measurements.*—Aperture (interior) $\}$ $la$=0.12 mm. Peristomice (exterior) $\}$ $lpe$=0.16–0.20 mm.

Zooecia $\left\{\begin{array}{l} Lz=1.00\text{–}1.25 \text{ mm.} \\ lz=0.30\text{–}0.40 \text{ mm.}\end{array}\right.$

*Variations.*—On the young fronds (figs. 6, 12) the median zooecia are unprovided with oral avicularia; the lateral zooecia bear only large avicularia. In the normal zooecia, there are two avicularia; the larger is adjacent to the lower lip of the rimule (fig. 8). In the old zooecia the large avicularium is lost among the tubules and opens then into the peristomie (figs. 9, 10. 11). The more the tubules are elongated the more the peristomice is enlarged and the more the micrometric measurements are increased. These are, therefore, often inferior to those which we give above; it is not rare to observe; $Lz=0.80$–1.00 by $lz=0.40$–0.45 mm. (fig. 8) Very rarely a thin separating thread limits the zooecia (fig. 6).

One of the distinctive characters of this species is a sort of small lyrula which is visible on the proximal border of the apertura in the interior of the zooecia (fig. 13).

The specific character of the species is the presence of the frontal sulci at the base of which the tubules open; they give to the tangential sections an especial and strange aspect (fig 15).

*Affinities.*—The species differs from *Metradolium obliquum* in which the rimule-spiramen is identical, in its frontal sulci and in its larger dimensions ($Lz>0.80$ mm).

It differs from *Metradolium transversum* also provided with sulci in its very large and unsymmetrical rimule-spiramen and in the almost constant presence of two oral avicularia.

*Occurrence.*—Claibornian (Gosport sand): One mile southwest of Rockville, Clarke County, Alabama (rare).

Lower Jacksonian (Moodys marl): Jackson, Mississippi (very common).

*Cotypes.*—Cat. No. 63850, U.S.N.M.

ANALYTICAL KEY TO SPECIES OF METRADOLIUM.

| | | |
|---|---|---|
| 1 | Spiramen present | 2. |
| | No spiramen | 3. |
| 2 | Large, salient lip between the spiramen and the peristomice | *M. labratulum.* |
| | No lip to the peristomice | *M. dissimile.* |
| 3 | Small, little distinct rimules | 4. |
| | Large, very distinct rimules | 5. |
| 4 | Large, transverse peristomice, often with sulci | *M. transversum.* |
| | Small peristomice ($lpe=0.10$–0.12 mm.) | *M. parvirimulatum.* |
| 5 | Large, symmetrical rimule, straight, rounded | *M. conveniens.* |
| | Large, unsymmetrical rimule, one lip being much lower than the other | **6.** |
| 6 | Large tremopores, large micrometric dimensions | *M. grande.* |
| | Small tremopores, oblique rimule | *M. obliquum.* |
| | Tremopores at the base of the sulci | *M. sulciferum.* |

### Genus LEIOSELLA Canu and Bassler, 1917.

1917. *Leiosella* Canu and Bassler, Synopsis American Early Tertiary Cheilostome Bryozoa, Bulletin 96, United States National Museum, p. 48.

The frontal is an olocyst. The peristomice of the ovicelled zooecia is of different form from that of the other zooecia; it is a lunar crescent and deprived of rimule-spiramen.

*Genotype.*—*Leiosella rostrifera* Canu and Bassler, 1917. Vicksburgian.

This genus differs from *Metradolium* only in the nature of the frontal which is here a very thick olocyst.

Of the three species mentioned, one only bears ovicells. Further researches are necessary.

### **LEIOSELLA ROSTRIFERA** Canu and Bassler, 1917.

Plate 92, figs. 11-17.

1917. *Leiosella rostrifera* Canu and Bassler, Synopsis American Early Tertiary Cheilostome Bryozoa, Bulletin 96, United States National Museum, p. 48, pl. 5, fig. 1.

*Description.*—The zoarium is free, bilamellar; the fronds are narrow, flat, claviform, bifurcated. The zooecia are elongated, distinct, ovoid; the frontal is smooth, convex, formed by a thick olocyst. The peristomice is irregular; the rimule-spiramen is bordered laterally by the oral avicularium. The apertura is elongated, ovoid, very oblique. The oral avicularium is large, transverse, salient, with the *beak* strong and curved; it is provided with a pivot and a large mandible, more or less spatulate. On the frontal, there are two small, elliptical avicularia with round mandible.

*Measurements.*—Peristomice $\begin{cases} hpe=0.30 \text{ mm.} \\ lpe=0.25 \text{ mm.} \end{cases}$ Apertura (interior) $\begin{cases} ha=0.11 \text{ mm.} \\ la=0.10 \text{ mm.} \end{cases}$

Zooecia (interior) $\begin{cases} Lz=0.90\text{–}1.00 \text{ mm.} \\ lz=0.25\text{–}0.30 \text{ mm.} \end{cases}$

*Variations.*—At the exterior the measurements are quite variable because of irregularity in calcification and the unequal development of the avicularium. The apertura is very oblique and elongated; in perspective in the interior (fig. 16) it appears transverse and elliptical. The oral avicularium on account of its great prominence is very fragile and easily broken (fig. 13); it is more or less lost in the thickness of the olocyst (figs. 14, 15). The small frontal avicularia are not always visible (fig. 15).

*Occurrence.*—Vicksburgian ("Chimney rock" of Marianna limestone): One mile north of Monroeville, Alabama (very common).

Vicksburgian (Red Bluff clay): Seven and one-half miles southeast of Bladen Springs, Alabama (common).

*Cotypes.*—Cat. No. 62597, U.S.N.M.

### **LEIOSELLA GRANDISORA,** new species.

Plate 92, fig. 18.

*Description.*—The zoarium is free, subcylindrical. The zooecia are indistinct, somewhat elongated; the frontal is small, hardly convex, and is formed of a thick olocyst. The peristomice is very *large,* funnel-shaped, provided with a large rimule-spiramen, little distinct; the apertura is large, elongated, somewhat oval. The ovicell is large, prominent, transverse; the peristomice of the ovicelled zooecia is elliptical and transverse. In the peristomie there is a large thin, triangular avicularium.

*Measurements.*—Peristomice (exterior) $\begin{cases} hpe=0.40\text{–}0.45 \text{ mm.} \\ lpe=0.30 \text{ mm.} \end{cases}$ Apertura (interior) $\begin{cases} ha=0.30 \text{ mm.} \\ la=0.25 \text{ mm.} \end{cases}$

Zooecia $\begin{cases} Lz=0.70 \text{ mm.} \\ lz=0.40\text{–}0.45 \text{ mm.} \end{cases}$

*Affinities.*—As the figured specimen is the only one found we are able to get only an imperfect idea of this very remarkable species. The attenuation of the rimule-spiramen in this species and in some other species of the same family is always an indication of a reinforcement of the operculum more chitinized and more rigid.

The species differs from *Leiosella orbicularia* in its larger micrometric dimensions and the absence of small frontal avicularia.

*Occurrence.*—Vicksburgian ("Chimney rock" of Marianna limestone): One mile north of Monroeville, Alabama (very rare).

*Holotype.*—Cat. No. 64296, U.S.N.M.

### LEIOSELLA ORBICULARIA, new species.

Plate 91. figs. 22, 23.

*Description.*—The zoarium is free, cylindrical, formed of two separable lamellae. The zooecia are distinct, almost *orbicular;* the frontal is smooth and convex, formed of a very thick olocyst. The peristomice is large, orbicular, placed in the middle of the zooecia; the rimule-spiramen is formed on one side by the oral avicularium; the aperture is elongated, very oblique, somewhat oval, the point below. On the border of the peristomie there is a large oral avicularium triangular, not salient, with thin wall, provided with a pivot. There are some small frontal avicularia, simple and orbicular, scattered among the peristomices.

*Measurements.*—Peristomice (interior) $\begin{cases} hpe=0.20\text{–}0.30\text{ mm.} \\ lpe=0.25\text{ mm.} \end{cases}$ Zooecia $\begin{cases} Lz=0.50\text{ mm.} \\ lz=0.40\text{–}0.45\text{ mm.} \end{cases}$

*Affinities.*—Only two specimens have been found. The great difference in form and position between the peristomice and the apertura is very remarkable. We are ignorant of the ovicell.

The species differs from *Leiosella grandisora* in its smaller micrometric dimensions and the presence of small frontal avicularia.

*Occurrence.*—Vicksburgian (Red Bluff clay): Red Bluff, Wayne County, Mississippi (rare).

*Holotype.*—Cat. No. 64294, U.S.N.M.

### Genus METROCRYPTA Canu and Bassler, 1917.

1917. *Metrocrypta* CANU and BASSLER, Synopsis American Early Tertiary Cheilostome Bryozoa, Bulletin 96, United States National Museum, p. 49.

The frontal is a tremocyst with tubules. The rimule-spiramen is wide and of very little depth. Ovicell unknown.

*Genotype.*—*Metrocrypta bucculenta* Canu and Bassler, 1917. Jacksonian.

The ovicell of this genus is unknown and it is therefore very doubtful that it should be introduced into this family. The oral avicularium is very rare; however, its presence seems to us the best character for classification.

### METROCRYPTA BUCCULENTA Canu and Bassler, 1917.

Plate 58, figs. 1–10.

1917. *Metrocrypta bucculenta* Canu and Bassler, Synopsis American Early Tertiary Cheilostome Bryozoa, Bulletin 96, United States National Museum, p. 49, pl. 5, fig. 2.

*Description.*—The zoarium is free, cylindrical, bifurcated. The zooecia are elongated, large, little distinct; the frontal is convex, porous, formed of a tremocyst placed on a thick olocyst. The peristomice is somewhat elongated, oval, its lower point formed of a wide rimule-spiramen; the peristomie is somewhat salient; the apertura (interior) is much smaller, orbicular, very oblique. The oral avicularium is very rare; it is quite large, prominent, triangular, adjacent to the peristomice, provided with a pivot placed very low.

*Measurements.*—Peristomice (exterior) $\left\{\begin{array}{l} hpe=0.30\text{–}0.35 \text{ mm.} \\ lpe=0.30 \text{ mm.} \end{array}\right.$ Apertura (interior) $\begin{array}{l} ha=0.15 \text{ mm.} \\ la=0.15 \text{ mm.} \end{array}$

Zooecia $\left\{\begin{array}{l} Lz=1.00 \text{ mm.} \\ lz=1.23 \text{ mm.} \end{array}\right.$

*Variations.*—The zooecia are sometimes distinct and separated by a prominent thread (fig. 3). The peristomie (fig. 6) is very wide and in proportion with the size of the peristomice; the apertura being small, we are ignorant of the use of the exaggerated development of this tube. The exterior and frontal walls are very thick (figs. 6, 7); but the interior walls are thin and very fragile (fig. 10). In the interior the apertura is almost invisible, because it is almost perpendicular to the plane of the frontal (fig. 10).

We have observed some interzooecial swellings; they are globular, porous, provided with an orbicular orifice (fig. 9). They are superposed on the tremocyst and always appear in connection with a peristomie (figs. 2, 8). Can this be the ovicell?

*Occurrence.*—Middle Jacksonian (Castle Hayne limestone): Wilmington, North Carolina (common).

*Cotypes.*—Cat. No. 62598, U.S.N.M.

### Genus OCHETOSELLA Canu and Bassler, 1917.

1917. *Ochetosella* Canu and Bassler, Synopsis American Early Tertiary Cheilostome Bryozoa, Bulletin 96, United States National Museum, p. 49.

The ovicell is hyperstomial and deeply imbedded in the distal zooecium. The rimule-spiramen is replaced by a small canal supported by a peristomial projection. The frontal is an olocyst perforated laterally by some areolae and covered by a uniform pleurocyst.

*Genotype.*—*Ochetosella jacksonica* Canu and Bassler, 1917.

*Range.*—Claibornian, Jacksonian.

At first glance, this genus appears close to *Palmicellaria*, but this is an error. The large avicularian mucro of that genus is replaced here by a small canal which is evidently the equivalent of the rimule-spiramen of the other genera of the family

Stomachetosellidae. When it exists, the oral avicularium is indeed in its place in the immediate vicinity of the peristomice and of the rimule-spiramen.

### OCHETOSELLA JACKSONICA Canu and Bassler, 1917.

Plate 15, figs. 1–10.

1917. *Ochetosella jacksonica* Canu and Bassler, Synopsis American Early Tertiary Cheilostome Bryozoa, Bulletin 96, United States National Museum, p. 50, pl. 5, fig. 3.

*Description.*—The zoarium is free, erect, cylindrical, bifurcated, often anastomosing. The zooecia are elongated, distinct, hexagonal, separated by a salient thread; the frontal is concave, bordered by large areolae, formed of a thin olocyst and covered by a uniform and finely granulated pleurocyst. The apertura is semilunar and invisible externally; the peristomice is very oblique, with undefined outlines, vaguely triangular. The ovicell is globular and deeply imbedded in the distal zooecia. The oral avicularium is rare.

*Measurements.*—Zooecia $\begin{cases} Lz = 1.10\text{–}1.20 \text{ mm.} \\ lz = 0.50 \text{ mm.} \end{cases}$

*Variations.*—The young zooecia have no separating thread (figs. 3–6); they have a mucro much developed and quite prominent (figs. 4, 5) which bears the characteristic small canal. The zooecia are thickened by the development of the pleurocyst which is deposited at first around the areolae (fig. 9) and afterwards over all the frontal (fig. 8). In these conditions, the mucro is of less and less prominence, but the small canal-like spiramen always persists. This same pleurocyst covers the ovicell (figs. 3, 10).

At the bifurcation of the branches, there is a large zooecium which bears a large special avicularium whose purpose is still to be learned.

*Affinities.*—This species is very easy to determine. It differs from *Ochetosella robusta* in its smaller zoarium, in its large, lateral areolae and in the absence of the zooecial peristomie.

*Occurrence.*—Upper Claibornian (Gosport sand): One mile southwest of Rockville, Clarke County, Alabama (very rare); Gopher Hill, Tombigbee River, Alabama (rare).

Lower Jacksonian (Moodys marl): Jackson, Mississippi (very common).

Middle Jacksonian: Wilmington, North Carolina (very common); near Lenuds Ferry, South Carolina (common); Eutaw Springs, South Carolina (common); 3¼ miles south of Perry, Georgia (common); 18 miles west of Wrightsville, Georgia (common); Rich Hill, Crawford County, Georgia (very common); Baldock, Barnwell County, South Carolina (very common); 17 miles northeast of Hawkinsville, Georgia (rare); one-half mile southeast of Georgia Kaolin Company mine, Twiggs County, Georgia (rare).

Upper Jacksonian (Ocala limestone): West bank Sepulga River, Escambia County, Alabama (rare).

*Cotypes.*—Cat No. 62599, U.S.N.M.

### OCHETOSELLA ROBUSTA, new species.

Plate 57, figs. 11–17.

*Description.*—The zoarium is free, cylindrical, branching. The zooecia are large, elongated, cylindrical; the frontal is very convex; it is terminated distally by a salient and almost complete peristomie; it is formed of a tremocyst with very small pores. The oral mucro bears a trenched spiramen and avicularium; the peristomice is very oblique; its outlines are undefined. The oral avicularium is round, simple and without pivot.

*Measurements.*—Zooecia $\begin{cases} Lz=1.20\text{–}1.30 \text{ mm.} \\ lz=0.65 \text{ mm.} \end{cases}$

*Variations.*—The development of the calcification gives to the zooecia some quite variable aspects which it is impossible to analyze, but which figures 14 to 17 represent sufficiently. Figure 12 represents a very curious case of an inversion of zooecia on the same branch.

*Affinities.*—This species is always easy to distinguish from *Ochetosella jacksonica* by its *large branches* and the absence of areolae.

*Occurrence.*—Middle Jacksonian: Wilmington, North Carolina (common); near Lenuds Ferry, South Carolina (rare).

*Cotypes.*—Cat. No. 64122, U.S.N.M.

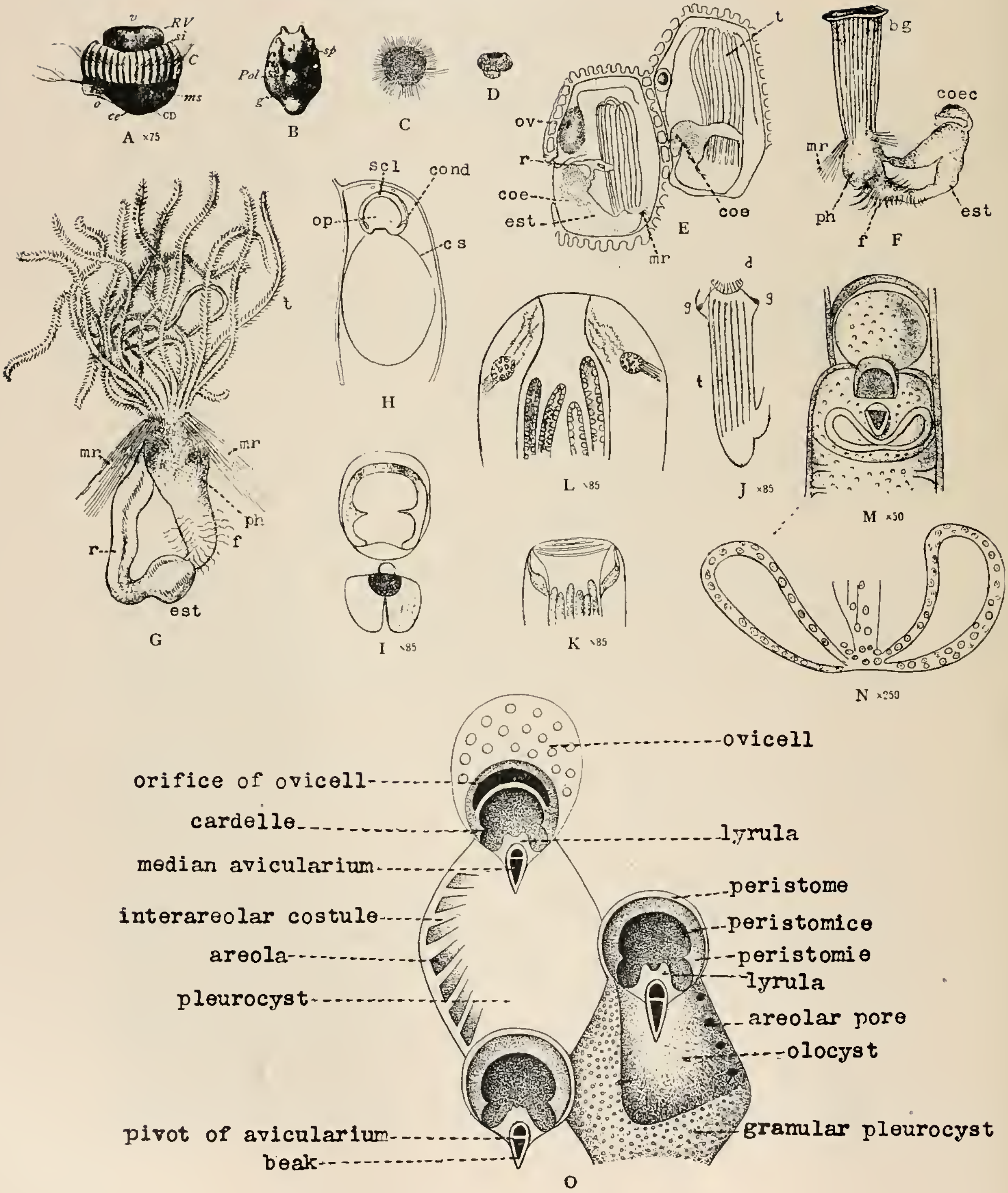
## Family SMITTINIDAE Levinsen, 1909.

*Anatomical bibliography.*—1865, Smitt, Skandinaviens Hafs-bryozoer, Ofversigt Kongl. Vetenskaps-Akademiens Förhandlinger, vol. 22, pl. 3, figs. 9, 10, 11; pl. 5, fig. 4.—1892. Waters, Observations on the Gland-like Bodies in the Bryozoa, Journal Linnean Society, London, Zoology, vol. 24, pl. 19, figs. 15, 16.—1900. Waters, Bryozoa from Frauz Joseph Land, pl. 10, figs. 8–17; pl. 12, figs. 3, 4.—1904. Waters. Expedition Antarctic Belge, Bryozoa, pl. 4, figs. 1, 2.—1909. Waters. Reports on the Marine Biology of the Sudanese Red Sea. XIII. The Bryozoa, Journal Linnean Society, London, vol. 31, pl. 14, fig. 14; pl. 15, fig. 11.

The ovicell which is hyperstomial and imbedded in the distal zooecia opens into the peristomie. The peristome is produced and channeled in front. The operculum is (not universally) very thin; the lower edge is straight or slightly curved inward and hardly separated from the ectocyst; the muscular attachments are usually a ridge on the border. There are very small oral glands often partly attached to the tentacular sheath. Spines.

This family is a very important one, but unfortunately our knowledge of the anatomy and embryology is too little to allow us to fix its exact limits. The development of the peristome is one of the essential characters; we continue to follow the same terminology as for the preceding families. The orifice of the peristome is the *peristomice* (secondary orifice of Hincks); it is irregular and its outlines are vague and undefined. The *apertura* is the zooecial orifice closed by the operculum; it is not always visible externally. The internal tube formed by the development of the peristome is the *peristomie.*

The calcification functions as in other genera. Nevertheless, the pleurocyst is a frequent occurrence, and the greater part of the time the two calcareous layers are separable.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lyrula
median avicularium
peristome
interareolar costule
peristomice
areola
peristomie
lyrula
pleurocyst
areolar pore
olocyst
pivot of avicularium
granular pleurocyst
beak
O

FIG. 130.—Anatomy of the Smittinidae.

FIG. 130.—Anatomy of the Smittinidae Levinsen, 1909.

A, B. *Porella levis* Fleming, 1828. A. Free larva, × 75. B. Ancestrula. (A, B after Barrois, 1877.)

*ca*, calotte (terminal bud);
*CD*, digestive cavity;
*cc*, portion of the body between the two branches of the stomach;
*est*, stomach;
*mi*, aboral mesoderm;
*ms*, oral mesoderm;
*ph*, pharynx;
*si*, furrow;
*g*, disseminated fat globules seen in the stages following fixation;
*pvl*, rudiment of the polypide;
*sp*, spines of cell.

C–E. *Mucronella peachi* Johnston, 1848. C, D. Ciliated embryoes. E. Zooecial anatomy. The place of the rectum does not appear to be exact. Letters as in figure G. (C–E after Smitt, 1865.)

F, G. *Porella cervicornis* Pallas, 1766. F. Polypide with the tentacles arranged in the tentacular sheath. G. The same with the tentacles extended. (F, G after Milne-Edwards, 1838.)

*bg*, edge of the tentacular sheath;
*coec*, caecum of the stomach;
*est*, stomach;
*mr*, retractor muscles of the polypide;
*f*, filiform appendages of alimentary canal;
*ph*, pharynx;
*r*, rectum;
*t*, tentacles.

H. *Smittina trispinosa* Johnston, 1838, *var. arborea* Levinsen, 1886. The compensatrix (*cs*) is attached to the operculum (*op*). Its orifice is overhung by a median lobe of the frontal shield. The condyles (*cond*) are at a much deeper level and are long recurved denticles, which are crossed by the submarginal lateral sclerites (*scl*) of the operculum. The author has not figured the parietal muscles. (After Harmer, 1902.)

I. *Smittina tripora* Waters, 1904. Section showing aperture with operculum, and below it the avicularian glands, with the mandible above the glands, × 85. (After Waters, 1904.)

J. *Smittina protecta* Thornely, 1907. Polypide removed from the zooecium, showing the small oral (vaginal of Calvet) glands (*g*), the diaphragm (*d*), and the tentacles (*t*), × 85. (After Waters, 1908.)

K. *Smittina ophidiana* Waters, 1878. Distal extremity showing the oral glands, × 85. (After Waters, 1892.)

L. *Smittina trispinosa* Johnston, 1838. Distal end, showing oral glands, × 85. (After Waters, 1892.)

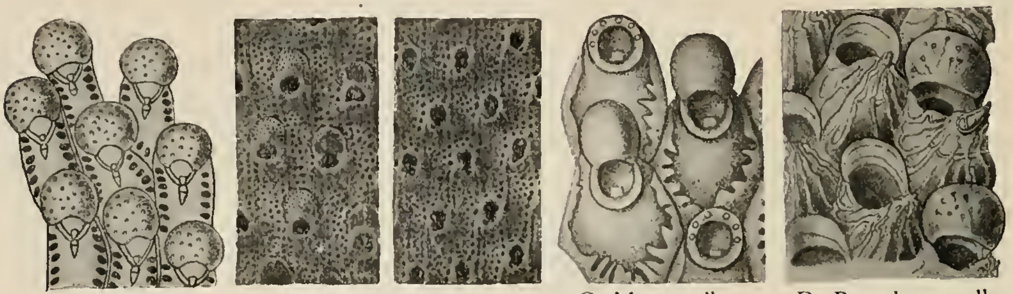
M, N. *Porella acutirostris* Smitt, 1867. M. Piece mounted in balsam, showing the avicularian glands through the semitransparent shell, × 50. N. Section of avicularian gland, × 250. (M, N after Waters, 1900.)

O. Sketch of several zooecia, showing terminology.

### Genus SMITTINA Norman, 1903.

1880. *Smittia* Hincks, British Marine Polyzoa, p. 340 (preoccupied).
1903. *Smittina* Norman, Notes on the Natural History of East Finmark, Annals and Magazine Natural History, ser. 7, vol. 12, p. 120.

In the apertura there is a lyrula and two cardelles. The frontal is an olocyst, perforated laterally with areolae and supporting a granular or costulate pleurocyst.


A. Smittina B. Plagiosmittia C. Mucronella D. Ramphostomella

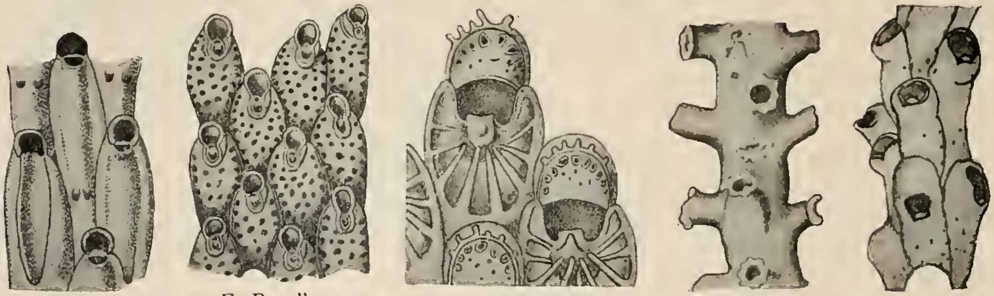

E. Cystisella F. Porella G. Umbonula H. Phoceana I. Bryocryptella

Fig. 131.—Genera of the family Smittiuidae, Levinsen, 1909.

A. *Smittina reticulata* MacGillivray, 1842.
B. *Plagiosmittia regularis* Canu and Bassler, 1917, × 20. Jacksonian of North Carolina.
C. *Mucronella peachi* Johnston, 1847, × 50. Recent.
D. *Ramphostomella costata* Lorenz, 1886. Recent.
E. *Cystisella saccata* Busk 1856, × 25. Recent.
F. *Porella cervicornis* Pallas, 1766, × 20. Recent.
G. *Umbonula verrucosa* Esper, × 25. Recent.
H. *Phoceana columnaris* Jullien, 1913, × 10. Recent.
I. *Bryocryptella torquata* Jullien, 1903. Recent.

The anterior indentation of the peristome contains an avicularium very often triangular. 13–19 tentacles.

*Genotype.*—*Smittina* (*Lepralia*) *reticulata* MacGillivray, 1842.

*Range.*—Lutetian-Recent.

The difference between *Smittina* and *Porella* appeared very difficult in the old days, and the form of the avicularium was alone taken into consideration. A form is not a good generic character, for semicircular avicularian mandibles of the *Porella* type are observed in three genera on the following species:

*Smittina* (*Lepralia*) *concinna* Busk, 1854.
*Smittina* (*Smittia*) *unispinosa* Waters, 1889.
*Umbonula* (*Cellepora*) *verrucosa* Esper, 1791.
*Ramphostomella* (*Eschara*) *scabra* Fabricius, 1780.

We prefer to consider the function of calcification clearly distinct on the genotypes of the two genera. It is for this reason that *Smittina majuscula* Nordgaard, 1905, seems to be a *Porella* even though a lyrula is present. Likewise *Porella glaciata* Waters, 1900, *Porella laevis* Fleming, 1828, and *Porella plana* Hincks are true *Smittina* on account of their frontal with pleurocyst, in spite of the presence of semicircular mandibles and the absence of lyrula.

Certain *Smittina* are ornamented with false tremopores, but in the interior areolar pores alone are visible.

*Historical.*—Hincks did not indicate a genotype. The first species described in his work is *Smittia landsborovi* Johnson, 1847, but unfortunately this is a quite variable species, very difficult to determine and whose synonymy is not yet exactly fixed. We prefer to adopt the second species *Smittia reticulata* MacGillivray which has been found fossil in the Miocene.

In 1903, Norman changed the name of *Smittia* to *Smittina* because the former was preoccupied in the Diptera. In 1909, Levinsen extended the meaning of the genus *Smittina* to inacceptable limits. Under the same name he has combined two absolutely different genera.

With Waters we can accept Norman's term but in the exact sense fixed by Hincks, for *Smittina* is one of the most natural genera of the family.

### SMITTINA COLLUM, new species.

Plate 58, figs. 11–17.

*Description.*—The zoarium is plurilamellar; it incrusts shells or algae over large surfaces. The zooecia are large, somewhat elongated, distinct, limited by a furrow or by a salient thread; the frontal is smooth, convex, bordered by a row of triangular areolae; it is formed of a smooth pleurocyst, placed on an olocyst perforated laterally, often separable. The peristomice is semilunar and bears a short rimule-spiramen; the peristomie visible externally is *salient* and bears laterally an avicularium; the peristome is thin and sharp; the lyrula is much imbedded, little visible, wide and flat. The ovicell is hyperstomial, placed on the distal zooecia, opening largely into the peristomie. The avicularium is straight, triangular, with pivot, the beak directed above.

*Measurements.*—Peristomice $\begin{cases} hpc = 0.20 \text{ mm.} \\ lpc = 0.12\text{–}0.15 \text{ mm.} \end{cases}$ Zooecia $\begin{cases} Lz = 1.00\text{–}1.10 \text{ mm.} \\ lz = 0.50 \text{ mm.} \end{cases}$

*Variations.*—On one zoarium the zooecia are not regularly arranged; they radiate from false ancestrulae forming thus many subcolonies. This phenomenon is frequent in the multilamellar zoaria.

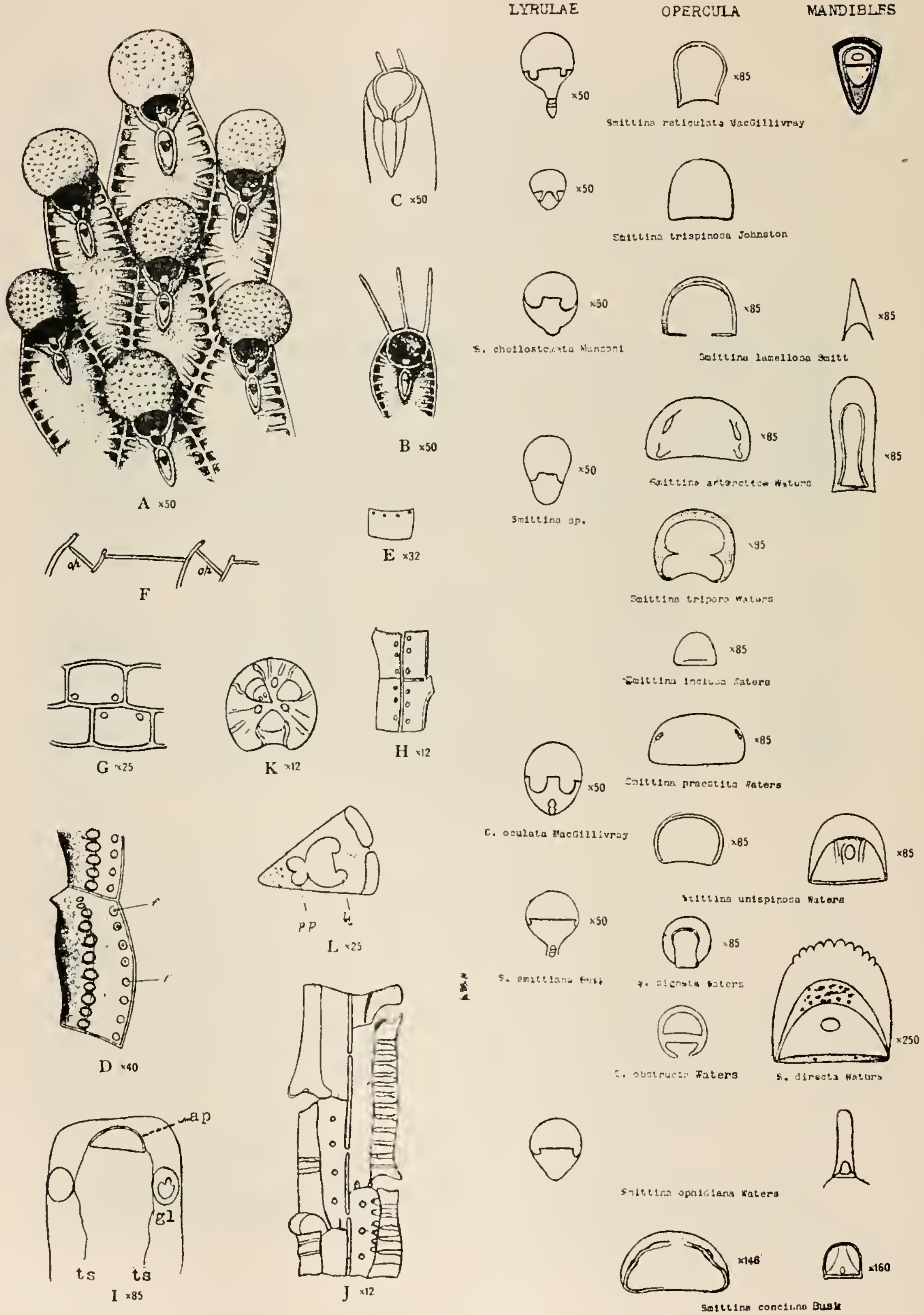

LYRULAE
OPERCULA
MANDIBLES
×50
×85
Smittina reticulata MacGillivray
×50
Smittina trispinosa Johnston
×50
S. cheilostomata Manzoni
×85
×85
Smittina lamellosa Smitt
×85
×85
×50
Smittina antarctica Waters
Smittina sp.
×95
Smittina tripora Waters
×85
Smittina inclusa Waters
×85
×50
Smittina praestita Waters
S. oculata MacGillivray
×85
×85
Smittina unispinosa Waters
×50
×85
S. smittiana Busk
S. signata Waters
×250
S. obstructa Waters
S. directa Waters
Smittina ophidiana Waters
×148
×160
Smittina concinna Busk
A ×50
C ×50
B ×50
E ×32
op
op
F
G ×25
K ×12
H ×12
r
r
D ×40
pp
t
L ×25
ap
gl
ts
ts
I ×85
J ×12

Fig. 132.—Genus *Smittina* Norman, 1903.

Fig. 132.—Genus *Smittina* Norman, 1903.

A–E. *Smittina reticulata* MacGillivray, 1882. A. Zooecia with ovicells, × 50. B. Young cell, × 50. C. Outline of a single adult zooecium, × 50. (A–C after Hincks, 1880.) D. Lateral view of a zooecium, × 40. E. End view of same, × 32. (D, F after Levinsen, 1894.)

F. *Smittina trispinosa*, var. *munita* Hincks, 1880. Section showing denticles, *op*, operculum, and spines. (After Waters, 1889.)

G–I. *Smittina antarctica* Waters, 1909. G. Transverse section showing lateral septulae, × 25. H. Section showing lateral septulae, × 12. I. Section showing aperture (*ap*), tentacular sheath (*ts*), and gland-like bodies (*gl*), × 85. (After Waters, 1904.)

J, K. *Smittina inclusa* Waters, 1904. Longitudinal section, × 12. K. Transversal section, × 12. (After Waters, 1901 and 1904.)

L. *Smittina directa* Waters, 1904. Transverse section of a zooecium showing (*rp*) septulae, (*ly*) lyrula, × 25. (After Waters, 1900.) M (right half of page). Lyrulae, opercula, and mandibles of *Smittina*. (After Waters, 1889, 1900, 1904, and Nordgaard, 1905.)

The line of areolae is often double or triple (fig. 11); they are generally small but they may become larger (fig. 12) when there is a formation of interareolar costules. In the interior the olocyst is smooth (fig. 15); the wide lyrula is quite visible.

*Affinities.*—This species is quite well characterized by its avicularium placed on the peristome which forms a sort of collar about the zooecium. In this character it differs clearly from *Smittina grandifossa* and from *Smittina coronata.*

*Occurrence.*—Middle Jacksonian: Wilmington, North Carolina (common); near Lenuds Ferry, South Carolina (rare).

*Cotypes.*—Cat. No. 64123, U.S.N.M.

### SMITTINA LABIATULA, new species.

Plate 59, figs. 7–10.

*Description.*—The zoarium is free, cylindrical, formed of from 4 to 6 longitudinal rows of zooecia. The zooecia are distinct, a little elongated, elliptical; the frontal is somewhat convex and surrounded by a row of irregular areolae. The apertura is much imbedded; it is hardly visible. The peristomice is limited laterally by two salient *lips,* between which is a large sinus terminated by a median avicularium. The ovicell is hyperstomial and is imbedded in the distal zooecia; it opens into the peristomie above the apertura.

*Variations.*—This species is remarkable in its pleurocystal variations, according to which the areolae are large (fig. 9) or small (fig. 7). The coalescence of the peristomie and the avicularium occasions in the vertical sections (fig. 10) an armature quite variable and difficult to comprehend. The oral, median avicularium sometimes becomes frontal; it is distant from the peristomice and triangular.

*Occurrence.*—Middle Jacksonian (Castle Hayne limestone): Wilmington, North Carolina (rare).

*Cotypes.*—Cat. No. 64125, U.S.N.M.

### SMITTINA GRANDIFOSSA, new species.

Plate 59, figs. 1–6.

*Description.*—The zoarium is plurilamellar, and incrusts shells or algae over large surfaces. The zooecia are large, somewhat elongated, distinct, hexagonal, separated by a thread more or less prominent; the frontal is smooth, little convex, bordered by a row of *large,* triangular *areolae;* it is formed of an olocyst perforated laterally, in which the elements are oriented toward the lyrula and which supports a smooth or costulate pleurocyst. The peristome is little salient, somewhat thick; it bears inferiorly a pseudo-rimule; the lyrula is salient and triangular; often there are two wide rimules. The ovicell is hyperstomial, globular, little salient, imbedded in the distal zooecia; it bears a porous area surrounded by a prominent collar; it opens largely into the peristomie.

*Measurements.*—Peristomice $\begin{cases} hpe=0.20 \text{ mm.} \\ lpe=0.20 \text{ mm.} \end{cases}$ Zooecia $\begin{cases} Lz=1.00\text{–}1.20 \text{ mm.} \\ lz=0.70 \text{ mm.} \end{cases}$

*Variations.*—On the same zoarium the zooecia are not regularly arranged; they radiate from false ancestrulae, forming thus so many subcolonies that they result in zooecial deformation. The line of areolae is often double or triple in the lower part of the zooecia (fig. 3). The separating thread is little salient (fig. 1) or very thick (fig. 4). In the latter case of great pleurocystal calcification the areolae are quite large.

The area of the ovicell is formed of a thin olocystal layer covered by a pleurocystal layer; it is very fragile and is very easily broken.

*Affinities.*—This species differs from *Smittina collum* in the absence of an avicularium on the peristome.

*Smittina grandifossa* differs from *Smittina coronata* in its larger dimensions ($Lz=1.00$ mm. and not 0.50 mm.) and in its smooth and not granular pleurocyst.

*Occurrence.*—Middle Jacksonian (Castle Hayne limestone): Wilmington, North Carolina (common).

*Cotypes.*—Cat. No. 64124, U.S.N.M.

### SMITTINA CORONATA, new species.

Plate 59, fig. 11.

*Description.*—The zoarium is unilamellar and creeps over algae. The zooecia are somewhat elongated, distinct, hexagonal, separated by a salient thread; the frontal is little convex and bordered laterally by a row of triangular areolae; the olocyst perforated laterally supports the granular pleurocyst, bordered with short interareolar costules. The peristome is thin and little prominent; the peristomice bears a pseudo-rimule, at the base of which is the lyrula. The ovicell is hyperstomial, placed on the distal zooecia, completely surrounding the apertura; it is formed of a porous area surrounded by a collar or *crown*, salient and smooth.

*Measurements.*—Peristomice $\begin{cases} hpe=0.15 \text{ mm.} \\ lpe=0.15 \text{ mm.} \end{cases}$ Zooecia $\begin{cases} Lz=0.55\text{–}0.65 \text{ mm.} \\ lz=0.45 \text{ mm.} \end{cases}$

*Affinities.*—This species differs from *Smittina grandifossa* in its smaller micrometric dimensions ($Lz=0.55$ mm. and not 1.00 mm.) and in the granulations of the pleurocyst.

It differs from *Smittina collum* in its smaller dimensions, in the absence of an oral avicularium, and in the presence of the pleurocystal granulations.

*Occurrence.*—Middle Jacksonian (Castle Hayne limestone): Wilmington, North Carolina (rare).

*Holotype.*—Cat. No. 64126, U.S.N.M.

### SMITTINA ANGULATA Reuss, 1865.

Plate 60, figs. 1–16.

1865. *Cumulipora angulata* Reuss, Die Foraminiferen, Anthozoen und Bryozoen des deutschen Septarienthones, Denkschriften der k. Akademie der Wissenschaften, Wien, vol. 25, Abth. 1, pl. 8, fig. 12.

*Description.*—The zoarium is large, massive, irregular, with lobed branches, multilamellar, hollow; it incrusts large algae or shells. The zooecia (in the more common form) are elongated, distinct, claviform; the frontal is convex, bordered by a line of round or triangular areolae; it is formed of a smooth olocyst, perforated laterally, supporting a porous pleurocyst. The apertura is semilunar with a convex proximal border; the peristomice is semilunar; the peristome is little salient; there is no lyrula. The ovicell is rare, placed on the distal zooecia, somewhat convex, completely surrounding the apertura, of the same nature as the frontal area. The median avicularium is peristomial and little elliptical, with pivot. On the line of the areolae there is another small elliptical avicularium, with pivot.

*Variations.*—The zooecial variations are extraordinary; they are occasioned by the pleurocystal calcification. The pleurocyst is developed above the olocyst (fig. 6) and may be detached from it; the calcareous deposit, at first irregular (fig. 5), is spread around the special pores (fig. 4); this is the most habitual aspect of the zooecia. The calcification increasing still more, the zooecia surround themselves by a salient thread and with interareolar costules (fig. 8) and when the thickness is great there is no trace of the zooecial divisions (figs. 12, 13). It is easy to distinguish a porous pleurocyst from a tremocyst by the inspection of the zooecial interior; here (fig. 14) the interior is smooth and only perforated laterally by small pores corresponding to the areolae.

The transversal section (fig. 10) shows the zooecial lamellae regularly superposed; the very thick walls (fig. 9) are perforated by tubules allowing the zooecia to communicate among themselves. The oldest lamellae of the zoarium are filled up with calcite (fig. 11) and thus form a more rigid substratum for the later lamellae; we do not know whether this calcification is of chemical or physiological origin.

The absence of the lyrula might permit this species to be separated in a special genus, but its mode of calcification is the same as all the other species of the genus *Smittina*.

Its large zoarial dimensions render this species very easy to determine; it is a good sized and characteristic fossil. Nevertheless, small zoaria are not rare and there are even some bilamellar ones.

*Occurrence.*—Lower Jacksonian (Moodys marl): Jackson, Mississippi (common).

Middle Jacksonian: Three and one-half miles north of Grovania, Georgia (rare).

Jacksonian (Zeuglodon zone): Bluff on south side Suck Creek, Clarke County, Mississippi (rare); Cocoa post office, Choctaw County, Alabama (very common).

Upper Jacksonian (Ocala limestone): Chipola River, east of Marianna, Florida; 1½ miles above Bainbridge, Georgia (rare).

Vicksburgian (Red Bluff): Red Bluff, Wayne County, Alabama.

*Geological distribution.*—Rupelian (Stampian) of Germany (Reuss).

*Plesiotypes.*—Cat. No. 64133, U.S.N.M.

### SMITTINA EXIGUA, new species.

Plate 59, figs. 17–19.

*Description.*—The zoarium is free, bilamellar with flat or undulated fronds; the lamellae, back to back, are separable. The zooecia are elongated, distinct, elliptical; the frontal is convex bordered by a line of areolar pores; the pleurocyst is porous with short interareolar costules. The apertura (interior) is transverse. semilunar with a proximal border very little convex; the peristomice is elongated, deformed inferiorly by the oral avicularium; the lyrula is very *small* and pointed. The ovicell is small, much imbedded in the distal zooecia; the frontal area is quite fragile. The median avicularium is very small, elliptical with pivot.

*Measurements.*—Peristomice $\begin{cases} hpe=0.14 \text{ mm.} \\ lpe=0.12 \text{ mm.} \end{cases}$ Apertura $\begin{cases} ha=0.12 \text{ mm.} \\ la=0.13\text{–}0.14 \text{ mm.} \end{cases}$

Zooecia $\begin{cases} Lz=0.60\text{–}0.80 \text{ mm.} \\ lz=0.30\text{–}0.32 \text{ mm.} \end{cases}$

*Variations.*—Like all the species with porous pleurocyst, this one has some zooecia of quite variable aspect; even in fossilization the pores are closed and the zooecia appear absolutely smooth.

Some closed zooecia, in which the apertura is replaced by a simple pore, appear quite frequently; they never have an avicularium. Their physiologic rôle is unknown.

*Affinities.*—This species differs from *Smittina strombecki* Reuss, 1865, in its larger micrometric dimensions ($Lz=0.60$ mm. and not 0.44 mm.), its porous and not costular pleurocyst, and in its smaller ovicell.

It differs from *Smittina sordida* in its pleurocyst, which is porous and not granular, and in the absence of all frontal avicularia.

Certain variations of *Porella portentosa* assume somewhat the aspect of this species, which differs, however, in the pleurocyst and nontremocystal frontal and in the nonbeaded peristome.

*Occurrence.*—Middle Jacksonian: Eutaw Springs, South Carolina (rare): Baldock, Barnwell County, South Carolina (rare); 3½ miles west of Grovania. Georgia (very rare); Rich Hill, Crawford County, Georgia (rare); ½ mile southeast of Georgia Kaolin Company Mine, Twiggs County, Georgia (very rare).

*Cotypes.*—Cat No. 64122, 64131, U.S.N.M.

### SMITTINA STROMBECKI Reuss, 1865.

Plate 59, figs. 12–14.

1865. *Lepralia strombecki* REUSS, Die Foraminifera, Anthozoen und Bryozoen des deutschen Septarienthones, Denkschriften der k. Akad. der wissenschaften Wien, vol. 25, Abth. 1, pl. 8, fig. 12.

*Description.*—The zoarium incrusts shells and bryozoa. The zooecia are small, elongated, fusiform, separated by a furrow or by a salient thread; the frontal is somewhat convex and bordered laterally by a line of small areolae; the pleurocyst is costular on the borders, apparently smooth in the middle, but actually porous under great magnification. The peristome is very little salient; the peristomice is semilunar and deformed inferiorly by the avicularium; the apertura is semilunar, with a proximal border slightly convex. The ovicell is hyperstomial placed on the distal zooecia; it opens above the apertura in the peristomie. The median avicularium is small, a little salient, oblique, nearly round.

*Measurements.*—Peristomice $\begin{cases} hpe=0.06\text{–}0.08 \text{ mm.} \\ lpe=0.10 \text{ mm.} \end{cases}$ Zooecia $\begin{cases} Lz=0.40\text{–}0.50 \text{ mm.} \\ lz=0.20\text{–}0.30 \text{ mm.} \end{cases}$

*Affinities.*—This small species is remarkable on account of the great facility with which the zooecia are more or less bordered on the same zoarium. We have not seen an appreciable difference from Reuss' species, and we believe our identification is good.

It differs from *Smittina exigua* in its much smaller micrometric dimensions ($Lz=0.50$ mm. and not 0.60 mm.), in its costular pleurocyst not porous in appearance, and in its incrusting zoarium.

It differs from *Smittina sordida* in the absence of lyrula, and of frontal avicularium and in the presence of interareolar costules.

*Occurrence.*—Middle Jacksonian: Eighteen miles west of Wrightsville, Johnson County, Georgia (rare); 3½ miles north of Grovania, Georgia (rare); one-half mile southeast of Georgia Kaolin Company Mine, Twiggs County, Georgia (rare); 17 miles northeast of Hawkinsville, Georgia (rare).

Upper Jacksonian (Ocala limestone): Old Factory, 1½ miles above Bainbridge, Georgia (rare); Chipola River, east of Marianna, Jackson County, Florida (rare).

*Geological distribution.*—Rupelian (Stampian) of Germany (Reuss).

*Plesiotypes.*—Cat. Nos. 64127–64129, U.S.N.M.

### SMITTINA PUNCTURATA, new species.

Plate 61, figs. 5–8.

*Description.*—The zoarium incrusts bryozoa or shells. The zooecia are large, swollen, utricular, distinct, elongated; the frontal is very convex, bordered by a line of small scattered areolae; it is formed of a pleurocyst very finely *porous;* the much developed peristomie bears an avicularium. The peristomice bears in front a short, false rimule; the peristome is thick and sharp; the lyrule is wide and bifurcated. The ovicell is small, globular, hyperstomial, of the same nature as the frontal. The avicularium is median, elongated, with pivot, its beak directed toward the top. The ancestrula is small, bordered by a mural rim and provided with a semilunar apertura.

*Measurements.*—Peristomice $\begin{cases} hpe=0.16 \text{ mm.} \\ lpe=0.15 \text{ mm.} \end{cases}$ Zooecia $\begin{cases} Lz=0.75\text{–}0.80 \text{ mm.} \\ lz=0.60\text{–}0.70 \text{ mm.} \end{cases}$

*Affinities.*—In the external aspect and its large dimensions this species is close to *Smittina collum*. It differs from it in the median position (and not lateral) of its avicularium and in its porous and never costular pleurocyst.

*Occurrence.*—Middle Jacksonian (Castle Hayne limestone): Wilmington, North Carolina (common).

*Cotypes.*—Cat. No. 64135, U.S.N.M.

### SMITTINA SORDIDA, new species.

Plate 59, figs. 15, 16.

*Description.*—The zoarium incrusts shells. The zooecia are elongated, distinct, separated by a furrow or a very thin salient thread, vaguely elliptical; the frontal is convex and formed by a thick pleurocyst, smooth or finely granulated. The peristome is salient and often bears two quite prominent lateral lips; the peristomice is elongated, irregular; the lyrula is little salient, acute, accompanied sometimes by two cardelles. The ovicell is large, salient, placed on the distal zooecia; it is hyperstomial and opens largely into the peristomie above the apertura; it is formed of a large area bordered by a salient collar. The small oral avicularium is triangular, the beak directed above. Quite frequently, a small frontal avicularium, salient and round, is placed laterally.

*Measurements.*—Peristomice $\left\{\begin{array}{l} hpe=0.15 \text{ mm.} \\ lpe=0.11 \text{ mm.} \end{array}\right.$ Zooecia $\left\{\begin{array}{l} Lz=0.55\text{–}0.70 \text{ mm.} \\ lz=0.35\text{–}0.40 \text{ mm.} \end{array}\right.$

*Variations.*—This species is not beautiful; its aspect is *sordid;* the zooecia have neither regularity nor symmetry. On the same fragment there are some zooecia with notched peristomes and other zooecia with perfect peristomes. At the same time there are some fragments entirely deprived of frontal avicularium.

This species is deprived of areolae; this is the reason that we suppose its frontal to be a pleurocyst; an olocyst would never have this irregularity and would be absolutely smooth. The presence of cardelles and of the lyrula is as usual for the genus. The very small number of specimens collected has not permitted us to study the interior to clear up the mystery of the constitution of its frontal.

*Occurrence.*—Upper Jacksonian (Ocala limestone): One and one-half miles above Bainbridge, Georgia (rare); below the Plant System railroad wharf, Bainbridge, Georgia (rare).

*Holotype.*—Cat. No. 64130, U.S.N.M.

### SMITTINA COPHIA, new species.

Plate 92, figs. 21–23.

*Description*—The zoarium is hollow, unilamellar, cylindrical; it incrusts very small algae. The zooecia are distinct, elongated, claviform, separated by an especially thick mural rim; the frontal is almost flat and formed of a pleurocyst with interareolar costules. The peristome is wide, salient, thick; the peristomice is elongated, elliptical; a very small lyrula is visible at the base of the peristomie. The ovicell is globular, quite salient, hyperstomial, placed on the distal zooecia; it is formed of a very large area quite finely porous, surrounded by a smooth, salient collar which surrounds it like a *cap;* it opens into the peristomie There is sometimes a small median avicularium on the proximal lip of the peristome.

*Measurements.*—Peristomice $\left\{\begin{array}{l} hpe=0.20 \text{ mm.} \\ lpe=0.15\text{–}0.20 \text{ mm.} \end{array}\right.$ Zooecia $\left\{\begin{array}{l} Lz=0.80\text{–}0.90 \text{ mm.} \\ lz=0.30 \text{ mm.} \end{array}\right.$

*Variations and affinities.*—The young zooecia (fig. 21) have thin margins and the ovicell is quite salient. The old zooecia are covered by the pleurocyst; the areolae are larger and the ovicell is immersed in the cap (fig. 23).

The present species differs from *Smittina telum* in which the zoarium is identical, in the absence of a large frontal avicularium and in the presence of a lyrula.

It differs from *Smittina reticuloides*, which is also provided with large costules, in its much larger micrometric dimensions and in the absence of the oral avicularium.

*Occurrence.*—Vicksburgian (Glendon member of Marianna limestone): West bank Conecuh River, Escambia County, Alabama (rare).

*Cotypes.*—Cat. No. 64298, U.S.N.M.

### SMITTINA AMPLA, new species.

Plate 93, figs. 10–16.

*Description.*—The zoarium is an Eschara in which the two lamellae, back to back, are inseparable. The zooecia are *large*, distinct, elongated, elliptical; the frontal is very convex and bordered with a line of large triangular areolae; it is formed of an olocyst partially perforated with large lateral pores, surmounted by a pleurocyst with large interareolar costules. The apertura (interior) is elliptical, transverse and bears a small lyrula, cylindical and salient; the peristome is thin, sharp, little salient, garnished with 4 thin spines; the peristomice is elongated elliptical or oval. The ovicell is large, globular, salient, carinated; it is formed of a smooth area surrounded by a salient collar; it covers much of the peristomice which it deforms; it is hyperstomial and opens largely into the peristomie. The oral avicularium is small, elliptical, very salient, deforming inferiorly the peristomice. At the side of the apertura there is often a large lateral avicularium, with pivot and a spatulate beak directed towards the top.

*Measurements.*—Apertura $\begin{cases} ha=0.18 \text{ mm.} \\ la=0.20 \text{ mm.} \end{cases}$ Peristomice $\begin{cases} hpe=0.30 \text{ mm.} \\ lpe=0.22 \text{ mm.} \end{cases}$

Zooecia $\begin{cases} Lz=0.90\text{–}1.00 \text{ mm.} \\ lz=0.22 \text{ mm.} \end{cases}$

*Variations.*—The lyrula, seen from the interior (fig. 14) appears short and cylindrical; on the exterior (fig. 11) it appears flat and broad. But the interest of this species is in its calcification (fig. 14); there is here as it were a juxtaposition of the olocyst and of a tremocyst; the latter only exists at the base of the zooecia; on the sides the line of the areolae become unique. This augmentation of the number of the areolae appears to correspond with a more intense pleurocystal calcification. There appears therefore to be a relationship between the tremopores and the areolae, both allowing the buds of the endocyst and the mesenchymatous fibers to pass at the same time.

The vertical section (fig. 16) shows how the apertura is oblique on the zooecial plane.

*Affinities.*—The presence of the very salient avicularian mucro characterizes quite well this species and permits us to differentiate it from the other large costulate species such as *Smittina colum*, *S. grandifossa*, and *S. coronata.*

*Occurrence.*—Vicksburgian (Marianna limestone): Salt Mountain 5 miles south of Jackson, Alabama (common); west bank of Conecuh River, Escambia County, Alabama (common); Murder Creek east of Castlebury, Conecuh County, Alabama (rare); near Claiborne, Monroe County, Alabama (common).

*Cotypes.*—Cat. No. 64300, U.S.N.M.

### SMITTINA RETICULOIDES, new species.

Plate 96, figs. 1–9.

*Description.*—The zoarium is free and bilamellar; the fronds are narrow or wide, flat or undulated; the two lamellae back to back are inseparable. The zooecia are elongated, distinct, narrow, fusiform, separated by a thread more or less salient; the frontal is flat surrounded by a line of triangular areolar pores numerous and quite large. The apertura is semilunar with a proximal border somewhat convex; the peristomice is oval and irregular; the peristome is little salient quite wide, smooth, enlarged at the base to bear the median avicularium. The ovicell is globular, salient; it is formed of a small circular area perforated by some large pores and with a large smooth collar; it is hyperstomial, placed on the distal zooecia and it opens into the peristomice. The median avicularium is small, triangular, with pivot, the beak above; it is placed on a thickening of the peristome.

*Measurements.*—Zooecia $\begin{cases} Lz=0.70 \text{ mm.} \\ lz=0.30 \text{ mm.} \end{cases}$

*Variations.*—The pleurocystal calcification is very intense and gives to the zooecia the most fantastic aspect sufficiently represented by figures 4, 5, 6. We have been successful with two tangential sections. The first (fig. 9) is taken at the level of the olocyst where one sees the elements irregularly grouped around the median axis; the areolae are large and round. The second section was made a little nearer the surface (fig. 8); it gives the construction of the interareolar costules, the elements of which are grouped transversely.

*Affinities.*—This species is very close to the recent *Smittina reticulata* MacGillivray, 1842; it differs from it in the area of the ovicell which is much smaller, ornamented only with some large pores and in the median avicularium which is much smaller and always placed on a thickening of the peristome and not on the frontal itself.

It differs from the variations of *Smittina telum* with very small avicularia in the much larger number of areolae (10) and in a less zooecial width (0.30 and not 0.40 mm.).

*Occurrence.*—Vicksburgian ("Chimney rock" of Marianna limestone): One mile north of Monroeville, Alabama (very common).

*Cotypes.*—Cat. No. 64309, U.S.N.M.

### SMITTINA TELUM, new species.

Plate 93, figs. 1–9.

*Description.*—The zoarium is free, cylindrical, hollow, unilamellar; it incrusts the small roots of algae. The zooecia are distinct, elongated rectangular; separated by a salient thread; the frontal is convex, bordered by a line of large areolae and almost entirely occupied by an enormous avicularium. The apertura is semilunar, somewhat transverse with a very little convex, proximal border; the peristomice is not deformed by the avicularium; there is no lyrula apparent; the peristome little salient in its distal part, is ornamented laterally with two large, smooth, salient lips. The ovicell is globular, salient; it is formed of a fragile and porous area surrounded by a little prominent collar; it is hyperstomial and opens into the peristomie. The avicularium is gigantic, salient, triangular like a *dart*, with pivot, the beak directed toward the bottom.

*Measurements.*—Apertura $\begin{cases} ha=0.10 \text{ mm.} \\ la=0.14 \text{ mm.} \end{cases}$ Zooecia $\begin{cases} Lz=0.60\text{–}0.90 \text{ mm.} \\ lz=0.35\text{–}0.40 \text{ mm.} \end{cases}$

*Variations.*—The median avicularia are not always constant in size; one may follow their successive development on figures 2 to 7. The lateral lips of the peristome are small (fig. 2) or very large (fig. 4); they may even be wanting (fig. 5) or be joined with the avicularium (fig. 4). The ovicells are smooth (fig. 6) or granular (fig. 7), according to the fineness of the grains of the pleurocyst. In the interior (fig. 8) the olocyst is perforated by very small areolar pores which are nevertheless very large exteriorly. A lyrula does not appear to be present.

The tangential section (fig. 9) indicates that the avicularian chamber is rather small and that it is the same as the one which covers the frontal of the zooecium. The white line which surrounds the zooecium and the size of the areolae indicate that this section has been made superficially at the level of the interareolar costules.

*Affinities.*—This species with its giant avicularium is very close to *Smittina canavarii* Neviani, 1900, of the Sicilian of Italy. It differs from it in the absence of lyrula, in the narrower zooecia, and in the larger number of areolae.

In its zoarial form of a hollow cylinder it approaches somewhat *Smittina cophia*, but *S. telum* differs in the presence of the gigantic avicularium.

*Occurrence.*—Vicksburgian ("Chimney rock" of Marianna limestone): One mile north of Monroeville, Alabama (very common).

*Cotypes.*—Cat. No. 64299, U.S.N.M.

### SMITTINA GRANULOSA, new species.

Plate 92, figs. 19, 20.

*Description.*—The zoarium is cylindrical and hollow. The zooecia are elongated, distinct, fusiform; the frontal is convex and formed of a very finely *granulose* pleurocyst The peristome is salient, thin, sharp; its anterior cleft contains a small elliptical avicularium; the apertura (interior) is semilunar. The ovicell is globular, salient; it is formed of a finely granular area, surrounded by a small improminent collar; it is hyperstomial, placed on the distal zooecium and opens largely into the peristomie. The median avicularium is elliptical, without pivot.

*Measurements.*—Peristomice $\begin{cases} hpe=0.10 \text{ mm.} \\ lpe=0.10 \text{ mm.} \end{cases}$ Zooecia $\begin{cases} Lz=0.55\text{–}0.60 \text{ mm.} \\ lz=0.25 \text{ mm.} \end{cases}$

*Affinities.*—The areolae disappear very easily through alteration in fossilization. Their absence on the fossils is therefore not a proof of a difference in structure. We do not hesitate to classify this species in *Smittina*, for the frontal is deceptive in this genus. Moreover the few specimens figured are the only ones found. It is probable that when better ones are discovered they will be found provided with areolae as usual in the genus.

*Occurrence.*—Vicksburgian (Marianna limestone): West Bank Conecuh River, Escambia County, Alabama (very rare); well in Escambia County, Alabama (very rare).

*Cotypes.*—Cat. No. 64297, U.S.N.M.

### SMITTINA ORBAVICULARIA, new species.

Plate 61, figs. 1–4.

*Description.*—The zoarium is unilamellar and creeps over algae. The zooecia are large, elongated, distinct, wide, claviform or turbinate. The frontal is little convex, surrounded by large crowded areolae and short interareolar costules. The peristome is thick and little salient; the peristomice is orbicular; the apertura (in the interior) is semilunar, transverse with a straight or somewhat concave proximal border; the lyrula is visible only in the interior; it is short and rectangular. The ovicell is small, little salient; it is formed of a very fragile area surrounded by a collar which is little visible; the ovicell is hyperstomial and opens into the peristomie. The avicularium is *orbicular*, with pivot; it is large, placed eccentrically with at least two orifices for the passage of the muscles which raise the semicircular mandible.

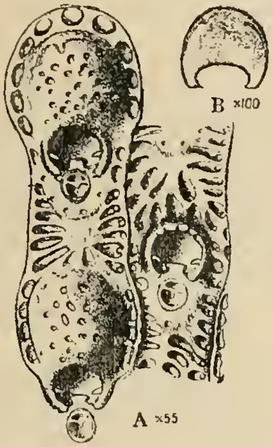


Fig. 132*n*.—Genus *Smittina* Norman, 1903.

A, B. *Smittina okaroensis* Levinsen, 1909. A. Several zooecia, × 55, showing vibracula provided with trabecular pivot. B. Operculum, × 100, with form different from the ordinary. (After Levinsen, 1909.)

*Measurements.*—Peristomice (exterior) $\begin{cases} hpe=0.12 \text{ mm.} \\ lpe=0.12 \text{ mm.} \end{cases}$ Apertura (interior) $\begin{cases} ha=0.10 \text{ mm.} \\ la=0.15 \text{ mm.} \end{cases}$

Zooecia $\begin{cases} Lz=0.90\text{–}1.00 \text{ mm.} \\ lz=0.40\text{–}0.50 \text{ mm.} \end{cases}$

*Affinities.*—The avicularium of this species resembles that of *Smittina okaroensis* Levinsen, 1909 (fig. 132*n*), dredged off New Zealand. "Its chamber which is separated from the zooecium by a broad, arched line, is provided at the margin with 3–5 pores, and the transverse bar (pivot) which divides the frontal area into two parts, is provided with a short, proximally directed process. The subopercular area, which is turned toward the aperture, has a transversally oval opening."[1]

This is a very unusual type of avicularium which well characterizes this fossil species.

*Occurrence.*—Middle Jacksonian: Wilmington, North Carolina (common); Eutaw Springs, South Carolina (rare); Near Lenuds Ferry, South Carolina (rare).

*Cotypes.*—Cat. No. 64154, U.S.N.M.

### SMITTINA (?) PUPA, new species.

Plate 95, figs. 1–9.

*Description.*—The zoarium is subcylindrical, hollow, bifurcated, unilamellar, or plurilamellar. The zooecia are long, distinct, fusiform, or elliptical; the frontal is convex, smooth, bordered by a line of large rather widely spaced areolae. The peristome is thick, salient; the peristomice is suborbicular; the apertura is oblique and semilunar. The ovicell is orbicular, little salient, ornamented by some large irregular pores. On the line of the areolae, there are two small, salient avicularia, with pivot, orbicular more or less symmetrically disposed.

*Measurements.*—Peristomice $\begin{cases} hpe=0.15 \text{ mm.} \\ lpe=0.12\text{–}0.15 \text{ mm.} \end{cases}$ Zooecia $\begin{cases} Lz=0.75\text{–}0.85 \text{ mm.} \\ lz=0.35 \text{ mm.} \end{cases}$

*Affinities.*—This species is unprovided with lyrula and the median avicularium is rarely visible; we must doubt its place in the genus *Smittina*. Nevertheless the other functions, ovarian and calcification are identical. It is remarkable to note that the larger the areolae are, the less numerous they are. The lateral avicularia always replace one of these areolae.

This species differs from *Smittina tubulata* Gabb and Horn, 1862, in the presence of two lateral avicularia and in the absence of median avicularium. In practice, the distinction between the two species is often difficult; there are many specimens of *Smittina tubulata* which resemble *Smittina pupa*.

On account of the size of the zoarium, this is a well characterized fossil.

*Occurrence.*—Vicksburgian ("Chimney rock" of Marianna limestone): One mile north of Monroeville, Alabama (very common).

*Cotypes.*—Cat. No. 64307, U.S.N.M.

### SMITTINA TUBULATA Gabb and Horn, 1862.

Plate 94, figs. 1–11.

1862. *Semieschara tubulata* Gabb and Horn, Monograph of the fossil Polyzoa of the Secondary and Tertiary formations of North America, Journal Academy Natural Sciences, Philadelphia, ser. 2, vol. 5, p. 122, pl. 19, fig. 5.

1890. *Semieschara tubulata* DeGregorio, Monographie de la Faune Eocenique de l'Alabama et surtout de celle de Claiborne de l'Etage Parisien, Annales de Geologie et de Paleontologie, Livraisons 7 and 8, p. 242, pl. 40, figs. 3, 24–28.

*Description.*—The zoarium is cylindrical. hollow, tubular, uni or plurilamellar; it incrusts small algae. The zooecia are large, long, elliptical, or tubular; the frontal is convex and surrounded by a line of areolae; it is formed of a smooth olocyst, perforated laterally, surmounted by a smooth or porous pleurocyst. The peristome is salient, thin, sharp; the peristomice is elongated and elliptical; the apertura is semilunar with a very concave proximal border; the lyrula is quite small and very fragile. The ovicell is hyperstomial and placed on the distal zooecia but is little salient; it is widely open in the peristomie. The median avicularium is small, orbicular, with a fragile pivot.

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[1] Levinsen, Morphological and Systematic Studies on the Cheilostomatous Bryozoa, p. 342, pl. 18, fig. 12.

*Measurements.*—Peristomice $\begin{cases} hpe=0.20 \text{ mm.} \\ lpe=0.15 \text{ mm.} \end{cases}$ Apertura $\begin{cases} ha=0.20 \text{ mm.} \\ la=0.15 \text{ mm.} \end{cases}$

Zooecia $\begin{cases} Lz=0.80\text{–}0.90 \text{ mm.} \\ lz=0.35 \text{ mm.} \end{cases}$

*Variations.*—The aspect of this species is quite variable; the most habitual (figs. 2, 3) shows a pleurocyst with much scattered pores. But on the younger zooecia (fig. 4) the pleurocyst is smooth and there is a line of areolae around each zooecium. The zooecia are sometimes separated by a salient thread on specimens strongly calcified (fig. 6).

On the plurilamellar zoaria the zooecia are irregularly oriented and often wider (fig. 7). The transversal sections show that the zooecia are provided with a very thick frontal (figs. 9, 11).

*Affinities.*—This species differs from *Smittina pupa* in the presence of a small median avicularium and the absence of lateral avicularia. Under the microscope the distinction is often very difficult.

Certain small specimens of *Smittina angulata* Reuss, 1866, resemble this species and their differentiation is difficult for the two species are quite variable. *Smittina tubulata* is deprived of lateral avicularia and the zooecia are longer.

The size of the zoarium makes this an easily recognized fossil.

*Occurrence.*—Vicksburgian ("Chimney rock" of Marianna limestone): One mile north of Monroeville, Alabama (very common).

Vicksburgian (Red Bluff clay): Seven and one-half miles southwest of Bladen Springs, Alabama (rare).

*Plesiotypes.*—Cat. No. 64302, U.S.N.M.

### Genus PLAGIOSMITTIA Canu and Bassler, 1917.

1917. *Plagiosmittia* Canu and Bassler, Synopsis of American Early Tertiary Cheilostome Bryozoa, Bulletin 96, United States National Museum, p. 51.

The ovicell opens into the peristomie. The frontal is a tremocyst. The avicularium is placed in the peristomie. The zooecia are oriented transversally to the zoarial fronds. Two large condyles are placed in the interior back of the apertura; they limit a small canal leading to the orifice of the compensatrix.

*Genotype.*—*Plagiosmittia regularis* Canu and Bassler, 1917.

*Range.*—Jacksonian-Vicksburgian.

This genus differs little from *Porella* Gray, 1848, in the nature of its functions. The difference lies in the irregularity of the place of the median avicularium and in the disposition of the zooecia on the fronds. Possibly it should be considered as only a subgenus.

### PLAGIOSMITTIA REGULARIS Canu and Bassler, 1917.

Plate 61, figs. 9–13.

1917. ***Plagiosmittia regularis*** CANU and BASSLER, Synopsis of American Early Tertiary Cheilostome Bryozoa, Bulletin 96, United States National Museum, p. 51, pl. 5, fig. 4.

*Description.*—The zoarium is bilamellar; the fronds are flat, narrow bifurcated. The zooecia are much elongated, distinct, separated by a thread or a furrow and are much narrowed proximally. The frontal is flat or little convex and formed of a tremocyst with numerous crowded pores. The peristome is thin, salient; the apertura is semilunar with a very concave proximal border; the peristomice is irregular, but it often contains a false rimule limited by the avicularium. The ovicell is globular, little prominent; it is formed of a large circular area with small numerous pores, surrounded by a smooth collar, little salient; it is imbedded in the distal zooecia and opens into the peristomie. The avicularium is peristomial, placed more or less laterally; the mandible moves in the peristomie.

*Measurements.*—Peristomice $\left\{\begin{array}{l} hpe=0.16\text{ mm.} \\ lpe=0.10\text{ mm.} \end{array}\right.$ Apertura $\left\{\begin{array}{l} ha=0.06\text{ mm.} \\ la=0.06\text{ mm.} \end{array}\right.$

Zooecia $\left\{\begin{array}{l} Lz=0.75\text{–}1.00\text{ mm.} \\ lz=0.20\text{ mm.} \end{array}\right.$

*Affinities.*—This species is quite *constant* on the whole; many zooecia, however, are marginated.

It differs from *Plagiosmittia porelloides* in its larger dimensions ($Lz=0.75$ and not 0.60 mm) and in its avicularium always placed laterally in the peristomie.

It differs from *Plagiosmittia virgula* in its larger micrometric dimensions ($Lz=0.75$ and not 0.56 mm.) and in the absence of the large median avicularium.

*Occurrence.*—Middle Jacksonian: Wilmington, North Carolina (common).

Upper Jacksonian (Ocala limestone): Old Factory one-half mile above Bainbridge, Georgia (rare); west bank Sepulga River, Escambia County, Alabama (common); Chipola River, east of Marianna, Jackson County, Florida (common).

*Cotypes.*—Cat. No. 62600, U.S.N.M.

### PLAGIOSMITTIA PORELLOIDES, new species.

Plate 61, figs. 14–18.

*Description.*—The zoarium is bilamellar; the fronds are flat, narrow, bifurcated. The zooecia are much elongated, distinct, separated by a furrow or a salient thread, much narrowed inferiorly; the frontal is flat or a little convex and formed of a tremocyst with numerous and crowded pores. The peristome is thin, salient; the peristomice is oval; the apertura is semilunar with a concave lower border. The ovicell is little salient, imbedded in the distal zooecium; it is formed of a large area with very fine pores, surrounded by a small, very thin collar; it opens into the peristomie. The small median avicularium is placed in the peristomie or in the peristomial sinus.

*Measurements.*—Peristomice $\begin{cases} hpe=0.06\text{–}0.08\text{ mm.} \\ lpe=0.12\text{–}0.14\text{ mm.} \end{cases}$ Zooecia $\begin{cases} Lz=0.56\text{–}0.60\text{ mm.} \\ lz=0.16\text{ mm.} \end{cases}$

*Affinities.*—This species differs from *Plagiosmittia regularis* in its smaller micrometric dimensions ($Lz=0.60$ and not 0.75 mm.) and in its avicularium which is median.

It differs from *Plagiosmittia virgula* in the absence of the large median avicularium, and in its smaller dimensions ($Lz=0.50$ and not 0.56 mm.).

*Occurrence.*—Middle Jacksonian: Wilmington, North Carolina (very common); Eutaw Springs, South Carolina (common); near Lenuds Ferry, South Carolina (very common).

*Cotypes.*—Cat. No. 64136, U.S.N.M.

### PLAGIOSMITTIA VIRGULA, new species.

Plate 62, figs. 1–7.

*Description.*—The zoarium is free, bilamellar; the fronds are narrow and bifurcated. The zooecia are elongated, elliptical, distinct, separated by a furrow; the frontal is little convex and formed of a tremocyst with much crowded pores. The peristome is thin, salient, sharp; the peristomice is oval; the apertura is semilunar with a straight proximal border. The ovicell is large, little salient; it is hyperstomial, imbedded in the distal zooecia, and opens largely into the peristomie; it is formed by a very finely porous circular area surrounded by a thin, little salient collar. The avicularium is median, placed in the peristomie; it is often developed and transformed into large unguiculate avicularia assuming the form of a *comma*.

*Measurements.*—Peristomice $\begin{cases} hpe=0.15\text{ mm.} \\ lpe=0.10\text{ mm.} \end{cases}$ Apertura $\begin{cases} ha=0.10\text{ mm.} \\ \mathrm{la}=0.10\text{ mm.} \end{cases}$

Zooecia $\begin{cases} Lz=0.45\text{–}0.50\text{ mm.} \\ lz=0.20\text{–}0.25\text{ mm.} \end{cases}$

*Affinities.*—The large frontal avicularium is not always developed; it is replaced by a small peristomial avicularium. The difference between this species and *Plagiosmittia porelloides* is then very small; only the micrometric dimensions are smaller ($Lz=0.50$ and not 0.60 mm.). The tangential section shows (fig. 4) that the median avicularium is often replaced by two peristomial avicularia.

The three species of *Plagiosmittia* are distinguished quite well from each other by their zooecial length:

*Plagiosmittia regularis*=0.75–1.00 mm.
*Plagiosmittia porelloides*=0.56–0.60 mm.
*Plagiosmittia virgula*=0.45–0.50 mm.

*Occurrence.*—Middle Jacksonian (Castle Hayne limestone): Wilmington, North Carolina (very common).

*Cotypes.*—Cat. No. 64137, U.S.N.M.

## Genus MUCRONELLA Hincks, 1880.

1880. *Mucronella* Hincks, British Marine Polyzoa, p. 360.

The frontal is surrounded by areolaé and covered by a pleurocyst, costulate or granular. There is a lyrula and often some cardelles in the peristomice inferiorly.

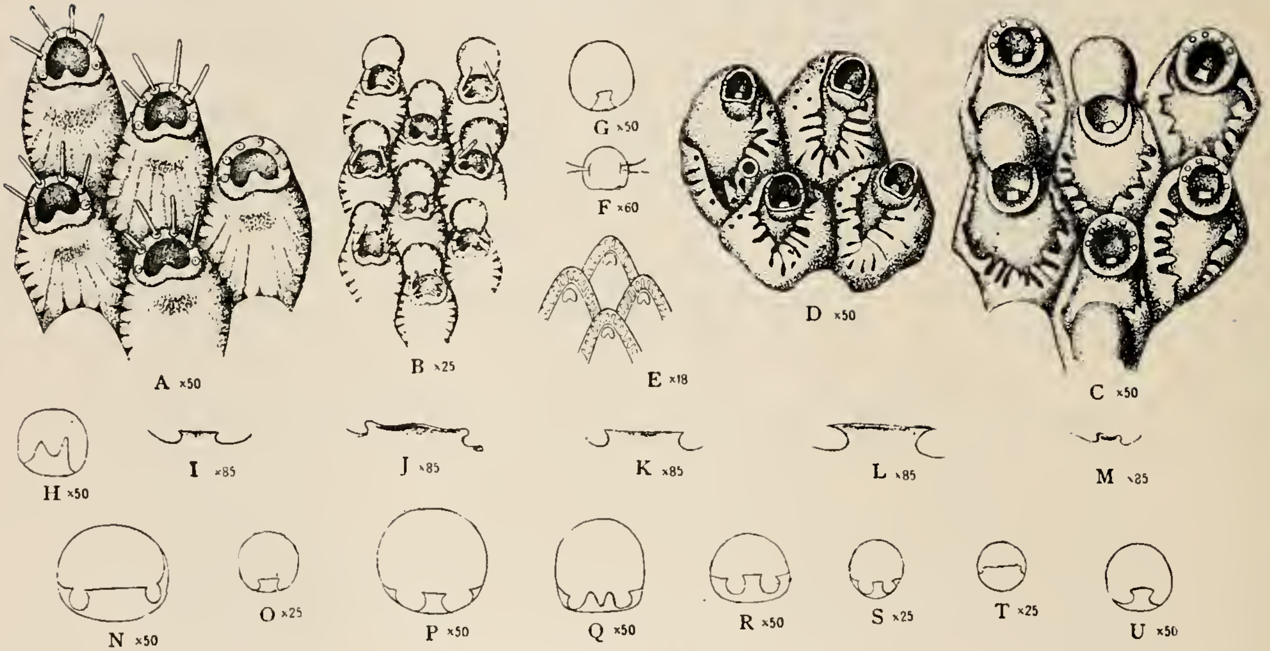

Fig. 133.—Genus *Mucronella* Hincks, 1880.

A–G. *Mucronella peachi* Johnston 1847. A. Zooecia, × 50. B. Zooecia with ovicells, × 25. C, D. Old conditions, × 50, showing the growth of the pleurocyst over the surface E. Septulae, × 18. (A–E after Hincks, 1880.) F. Operculum, × 60. (After Levinsen, 1894.) G. Lyrula, × 50. (After Waters, 1889.)

H–U. Lyrulae, species of *Mucronella*. H–I. *M. ventricosa* Hassall, 1841, × 50, and × 85. (After Waters, 1889.) J. *M. labiata* Boeck, 1861, × 85. (After Nordgaard, 1861.) K. *M. abyssicola* Norman, 1868, × 85. L. *M. laqueata* Norman, 1868, × 85. M. *M. peachi* Johnston, 1847, × 85. (K–M after Nordgaard, 1905.) N. *M. porosa* Hincks, 1881, × 50. O. *M. variolosa* Johnston, 1838, × 25. P. *M. elleri* MacGillivray, 1868, var. *biaviculata* Waters, 1889, × 50. Q. *M. biincisa* Waters, 1882, × 50. R. *M. rostrata* Hincks, 1880, × 50. S. *M. levis* MacGillivray, 1882, × 25. T. *M. spinosissima* MacGillivray, 1879, × 25. U. *M. diaphana* MacGillivray, 1879, × 50. (N–U after Waters, 1889.)

*Genotype.*—*Mucronella* (*Lepralia*) *peachi* Johnston, 1847.

*Range.*—Jacksonian-Recent.

The limits of this genus were rigorously established in 1904, by Waters. It differs from *Smittina* in the replacement of the avicularium by a mucro, that is to say, by an organ which we know to be almost equivalent.

The recent species of this genus are:

*Mucronella* (*Lepralia*) *peachi* Johnston, 1847.
*Mucronella* (*Lepralia*) *ventricosa* Hassall, 1841.
*Mucronella* (*Lepralia*) *variolosa* Johnston, 1847.
*Mucronella teres* Hincks, 1881.
*Mucronella crozetensis* Waters, 1904.

The known fossil species are:

*Mucronella* (*Lepralia*) *hörnesi* Reuss, 1865. Oligocene of Germany.
*Mucronella* (*Lepralia*) *grotriani* Reuss, 1865. Oligocene of Germany.

### MUCRONELLA PATENS, new species.

Plate 62, fig. 10.

*Description.*—The zoarium incrusts shells. The zooecia are distinct, *wide*, hexagonal; the frontal is convex, and surrounded by a double row of small areolae, much crowded. The peristome is salient, wide, its proximal portion is a very salient and erect mucro; the lyrula is small and triangular. The ovicell is hyperstomial and is placed on the distal zooecium; it is small, globular, salient, smooth; its orifice is placed just at the level of the mucro.

*Measurements.*—Peristomice $\begin{cases} hpe=0.10 \text{ mm.} \\ lpe=0.15 \text{ mm.} \end{cases}$ Zooecia $\begin{cases} Lz=0.60\text{–}0.70 \text{ mm.} \\ lz=0.75 \text{ mm.} \end{cases}$

*Affinities.*—This species is quite well characterized by its great zooecial width; all the known species have some elongated zooecia.

*Occurrence.*—Middle Jacksonian (Castle Hayne limestone): Wilmington, North Carolina (rare).

*Holotype.*—Cat. No. 64139, U.S.N.M.

### MUCRONELLA GRANULOSA, new species.

Plate 62, figs. 8, 9.

*Description.*—The zoarium incrusts bryozoa. The zooecia are distinct, little elongated, hexagonal; the frontal is convex, surrounded by a line of small areolae and formed by a regularly *granular* pleurocyst. The peristome is thin, sharp, little salient; it bears on the anter 4 to 6 spines and on the poster a lamellar mucro, oblique, very prominent and partially hiding the apertura; a small lyrula and two very small cardelles are visible at the base of the peristomie.

*Measurements.*—Peristomice $\begin{cases} hpe=0.08 \text{ mm.} \\ lpe=0.14 \text{ mm.} \end{cases}$ Zooecia $\begin{cases} Lz=0.51 \text{ mm.} \\ lz=0.40 \text{ mm.} \end{cases}$

*Affinities.*—This species is very elegant; it is rather rare that the elements of the pleurocyst are deposited with such regularity; however, this phenomenon exists in *Mucronella variolosa* Johnston, 1847. A single specimen has been found, incomplete, for the ovicell is wanting, but it appears interesting to us on account of its elegance alone.

*Occurrence.*—Lower Jacksonian (Moodys marl): Jackson, Mississippi (very rare).

*Holotype.*—Cat. No. 64138, U.S.N.M.

### Genus RHAMPHOSTOMELLA Lorenz, 1886.

1886. *Rhamphostomella* Lorenz, Bryozoen von Jan Mayen, Die Oesterreichische Polarstation Jan Mayen, vol. 3, p. 11.

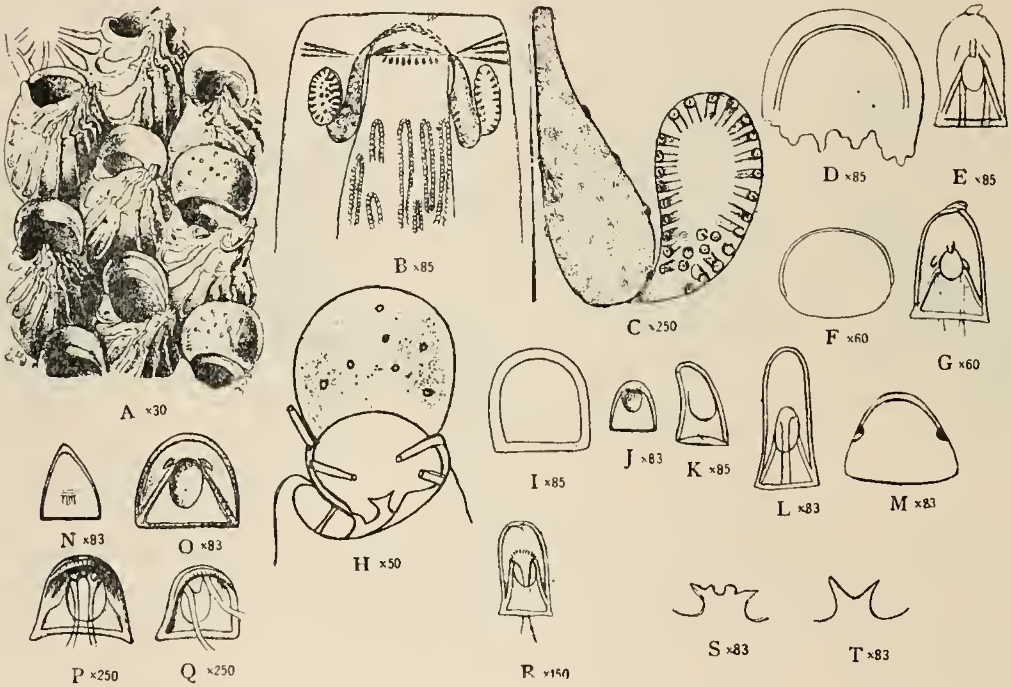

Fig. 134.—Genus *Rhamphostomella* Lorenz, 1886.

A–G. *Rhamphostomella costata* Lorenz, 1886. A. Zooecia, × 30. (After Lorenz, 1886.) B. Section showing the oral glands terminating near the diaphragm, × 85. C. Gland, × 250. D, E Operculum and avicularian mandible, × 85. (B–E after Waters, 1900.) F, G. Operculum and avicularian mandible, × 60. (After Lorenz, 1886.)

H–K. *Rhamphostomella plicata* Smitt, 1867. H. Ovicell and the anterior part of the zooecium, × 50. (After Nordgaard, 1906.) I, K. Operculum and avicularian mandible, × 85. (After Waters, 1900.) J. Avicularian mandible, × 83.

L. Avicularian mandible, × 85.

M, N. *Rhamphostomella contigua* Smitt, 1867. Operculum and avicularian mandible, × 83.

O. *Rhamphostomella scabra* Smitt, 1867. Avicularian mandible, × 83. (J–O after Nordgaard, 1905.)

P, Q. *Rhamphostomella radiatula* Hincks, 1877. Avicularian mandibles, × 250. (After Lorenz, 1886.)

R. *Rhamphostomella bilaminata* Lorenz, 1886. Avicularian mandible, × 150. (After Lorenz, 1886.)

S, T. *Rhamphostomella spinigera* Lorenz, 1886. Different forms of lyrula, × 83. (After Nordgaard, 1906.)

The operculum closes the ovicell, which is hyperstomial; it is thin and delicate, but there is a raised circular ridge. There is a very narrow lyrula, before an asymmetrical sinus. The frontal is a pleurocyst with costules. Before the orifice of the ovicell and at the same height, there is a very large avicularium, oblique.

salient and placed eccentrically; 18 tentacles. The oral glands are much developed.

*Genotype.*—*Rhamphostomella costata* Lorenz, 1886.

*Range.*—Priabonian—Recent.

The only known fossil species is *Rhamphostomella brendolensis* Waters, 1891, from the Priabonian of Vicentin.

### RHAMPHOSTOMELLA SIMPLEX, new species.

Plate 8, figs. 11, 12.

*Description.*—The zoarium incrusts shells. The zooecia are little distinct; the frontal is convex and formed of a pleurocyst very finely granulated. The apertura is oblique, imbedded, hidden; it bears a very small lyrula. The peristome bears two spines. The ovicell is hyperstomial, placed on the distal zooecia; it opens largely above the apertura and in front of the avicularium; it is formed of an area with very fine pores surrounded by a scarcely distinct collar. The avicularium is enormous, quite salient above the apertura; it is always placed obliquely and opens at the side of the apertura. The ancestrula is a small membraniporoid zooecium.

*Measurements.*—Zooecia $\begin{cases} Lz = 0.30 \text{ mm.} \\ lz = 0.20 \text{ mm.} \end{cases}$

*Affinities.*—This species is rather difficult to study because of its small dimensions. Our specimens are well preserved, and at an enlargement of 40 diameters they show very clearly the essential characters of *Rhamphostomella* in their more *simple* and more regular manifestations. The areolae are very rarely visible because of their very small dimensions.

*Rhamphostomella simplex* differs from *Rhamphostomella convexa* in its indistinct zooecia and in the opening of the avicularium which is invisible exteriorly and turned toward the apertura.

It differs from *Rhamphostomella brendolensis* in the absence of the large frontal avicularium.

*Occurrence.*—Wilcoxian (Bashi formation): Woods Bluff, Alabama (rare).

*Cotypes.*—Cat. No. 63829, U.S.N.M.

### RHAMPHOSTOMELLA BRENDOLENSIS Waters, 1891, var. AMERICANA, new variety.

Plate 62, fig. 11.

1891. *Rhamphostomella brendolensis* Waters, North Italian Bryozoa, Quarterly Journal Geological Society London, vol. 47, p. 23, pl. 3, figs. 10, 11.

*Description.*—The zoarium incrusts shells. The zooecia are little distinct, elongated; the frontal is convex and formed of an irregularly and finely granulated pleurocyst. It has no peristome; the peristomice bears an asymmetrical sinus placed between two very salient avicularia of which one is always larger than the other; the apertura is oblique, deep, hidden; the lyrula is flat and rather long. The ovicell is imbedded in the distal zooecia; it is little salient and smooth. On the frontal and placed in all directions there is a very large avicularium with small opesium and of which the mandible is rounded like the beak of a duck.

*Measurements.*—Zooecia $\begin{cases} Lz=0.35 \text{ mm.} \\ lz=0.25 \text{ mm.} \end{cases}$

*Affinities.*—The European type has distinct and marginated zooecia; the large frontal avicularium appears to us as placed nearer the apertura. These insignificant differences do not permit us to make a distinct species out of our American specimens.

The presence of the large frontal avicularium differentiates clearly this species from *Rhamphostomella simplex* and *Rhamphostomella convexa.*

*Occurrence.*—Middle Jacksonian: Wilmington, North Carolina (rare); Eutaw Springs, South Carolina (very rare).

*Geological distribution.*—Priabonian of the Vicentin (Waters).

*Holotype.*—Cat. No. 64140, U.S.N.M.

### RHAMPHOSTOMELLA CONVEXA, new species.

Plate 62, fig. 12.

*Description.*—The zoarium incrusts bryozoa. The zooecia are distinct, elliptical, a little elongated, separated by a furrow; the frontal is very *convex* and is formed of a pleurocyst very finely and very irregularly granulated. The peristome is little salient and bears two symmetrical spines; the peristomice bears an asymmetrical sinus formed by a quite salient oral avicularium with pivot and opening exteriorly; the aperture is oblique, imbedded, hidden by the oral avicularium. The ovicell is small, salient, placed on the distal zooecium; it is very widely open above the apertura and faces the avicularium.

*Measurements.*—Zooecia $\begin{cases} Lz=0.35\text{–}0.45 \text{ mm.} \\ lz=0.25\text{–}0.30 \text{ mm.} \end{cases}$

*Affinities.*—In this species it is absolutely impossible that the operculum could close the ovicell; it is closed by the ectocyst itself or by a special membrane. We can only form an hypothesis, for we are totally ignorant of the larval system of the Smittinidae in general.

This species differs from *Rhamphostomella simplex* in its zooecia distinct and convex, and in its oral avicularium, which opens exteriorly and not in the peristomie.

It differs from *Rhamphostomella brendolensis* Waters, 1891, in the absence of the large frontal avicularium.

*Occurrence.*—Middle Jacksonian: Rich Hill, Crawford County, Georgia (rare); near Lenuds Ferry, South Carolina (rare).

Upper Jacksonian (Ocala limestone): Old Factory, 1½ miles above Bainbridge, Georgia (rare).

*Holotype.*—Cat. No. 64141, U.S.N.M.

### Genus CYSTISELLA Canu and Bassler, 1917.

1917. *Cystisella* Canu and Bassler, Synopsis American Early Tertiary Cheilostome Bryozoa, Bulletin 96, United States National Museum, p. 53.

The frontal is an olocyst. It bears a very wide avicularian chamber in which there is a pair of large glands. The mandibles have a lucida in the middle. (Waters).

*Genotype.—Cystisella* (*Porella*) *saccata* Busk, 1856.

*Range.*—Midwayan-Recent.

"In *Porella saccata* it [the ovicell] is many layered, as thin calcareous layers, presumably gymnocyst [our olocyst] layers, continually grow over the ooecium, not only from the distal zooecium but also from the two neighboring zooecia, and we can see as a rule three, distinctly separated, thin covering plates on their surface." (Levinsen, 1909, p. 336.)

#### CYSTISELLA MIDWAYANICA Canu and Bassler, 1917.

Plate 8, figs. 5, 6.

1917. *Cystisella midwayanica* Canu and Bassler, Synopsis American Early Tertiary Cheilostome Bryozoa, Bulletin 96, United States National Museum, p. 53, pl. 5, fig. 6.

*Description.*—The zoarium incrusts shells. The zooecia are distinct, somewhat elongated, hexagonal, separated by a furrow or a thin salient thread; the frontal is very convex and very finely granulated. The peristome is thin, little salient in its distal part; it bears some spines; the peristomice is elliptical and deformed inferiorly by the avicularium. The avicularium forms a long chamber, median and conical; its orifice is little circular and turned toward the apertura.

*Measurements.*—Peristomice $\begin{cases} hpe = 0.10 \text{ mm.} \\ lpe = 0.14 \text{ mm.} \end{cases}$ Zooecia $\begin{cases} Lz = 0.40 \text{ mm.} \\ lz = 0.30 \text{ mm.} \end{cases}$

*Occurrence.*—Midwayan (Clayton limestone): Luverne, Crenshaw County, Alabama (very rare); one mile west of Fort Gaines, Georgia (rare).

*Cotypes.*—Cat. No. 62606, U.S.N.M.

### Genus PORELLA Gray, 1848.

1848. *Porella* Gray, List of British Animals in collection British Museum, Centroniae, pp. 127, 148.

The ovicell opens into the peristomie; it is porous, imbedded in the distal zooecium. The apertura is semilunar. Neither lyrula nor cardelles. The operculum is almost straight in its proximal part, with rounded corners; there is a muscular prominence a little distance from the edge. In front of the apertura there is an avicularium; the mandible is semicircular and has well marked thickenings formed of diagonal bars. The frontal is a tremocyst with tubules. 20 tentacles.

*Genotype.—Porella* (*Millepora*) *cervicornis* Pallas, 1766.

*Range.*—Lutetian-Recent.

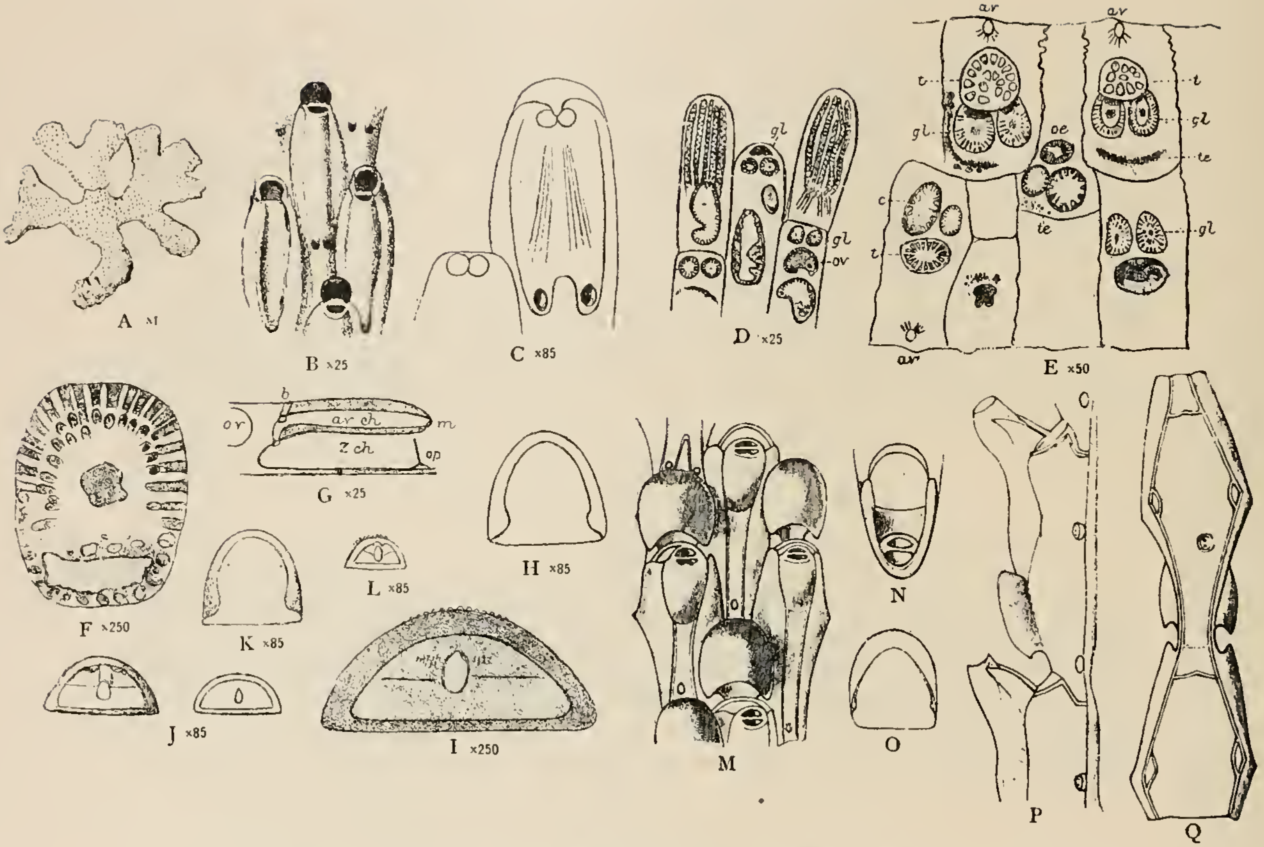

FIG. 135.—Genus *Cystisella* Canu and Bassler, 1917.

A–J. *Cystisella saccata* Busk, 1856. A. Zoarium, natural size. (After Nordgaard, 1905.) B. Specimen boiled in caustic potash showing the large avicularian chamber, that of the left zooecium broken away; also showing the pores at the base of the avicularian chamber, × 25. C. The interior of a portion, × 85, in which there are no polypides showing the glands reduced to two small globes attached to the fleshy tissue. In the avicularian chamber there are two very long muscles, and at the base there are the two characteristic pores. D. Section showing the position of the oral glands (*gl*), which are behind the tentacles so that they are not seen in the zooecia cut through near the frontal surface, (*ov*), ovum, × 25. E. Transverse section showing the large oral glands (*gl*), the avicularian sheath (*av*), the tentacles (*t*) in their sheath, esophagus (*oe*), caecum (*c*), testes (*te*), × 50. F. Oral gland, × 250. In the upper part the cells are partly absorbed. G. Diagrammatic section, × 25, showing the frontal pore connected through a rosette plate with the avicularian chamber, which farther down is similarly connected with the zooecium. *av. ch.*, avicularian chamber; *m*, mandible; *op*, operculum; *ov*, ovicell; *zch*, zooecial chamber. H. Operculum, × 85. I, J. Avicularian, mandible, × 250 and × 85.

K, L. *Cystisella elegantula* D'Orbigny, 1852. Operculum, × 85, and avicularian mandible, × 85.

M–Q. *Cystisella fragilis* Levinsen, 1916. M. Zooecia and ooecia, frontal surface. N. Aperture, much enlarged. O. Operculum. P. Zooecia in lateral view. Q. Basal wall of the zooecia. (After Levinsen, 1916.)

This genus differs from *Smittina* only in the calcification; the tremocyst replaces the pleurocyst. There are, however, some other secondary differences. The mandible of the avicularium is semicircular; it is generally (but not universally) triangular in *Smittina*. The lyrula is wanting in *Porella*; however, *Porella majuscula* Nordgaard, 1905, *Porella minuta* Norman, 1868, *Porella irregularis*, new species, and *Porella coronata*, new species, have an apparent lyrula.

The median avicularium is quite variable. In the same species it may be quite salient or buried in the peristomie, according to the thickness of the tremocyst; these variations make the determination of the species very difficult. Some species have the avicularium always salient; others, on the contrary, have an invisible avicularium, and only abrasion of the surface will reveal it.

*Historical.*—The genera *Smittina* and *Porella* are two quite natural genera which have been admirably described by Hincks, but of which he has not given the exact limits, occasioning thus some hesitation among collectors. Waters, in 1900, recognized the necessity of making two groups in the genus *Porella*, according to the nature of the mandible. The first group is very homogeneous and is the genus *Porella* as Levinsen limited it in 1909, and as we now understand it. The second group is less homogeneous, for the presence of a lucida on the mandible does not appear to correspond to an important physiologic function. In 1909 Levinsen thought *Porella saccata* Busk, 1856, belonged to a distinct genus; this is also our opinion and we have created the genus *Cystisella*. Likewise he thought that *Porella acutirostris* might serve as genotype for another genus. On the other hand, we think that *Porella margaritigera* Quoy and Gaymard, 1833, may belong to a different genus, for which we propose *Hippadenella* (see p. 402). Still further studies are necessary. *Palmicellaria* is a zoarial subgenus which may be conveniently preserved.

### PORELLA OBLIQUA, new species.

Plate 14, fig. 17.

*Description.*—The zoarium incrusts shells. The zooecia are small, a little elongated, little distinct; the frontal is little convex and formed by a tremocyst with large pores. The apertura is semilunar; the peristome is smooth, thin, more or less salient. The ovicell is hyperstomial and opens into the peristomie; it is formed of a porous area surrounded by a smooth collar. The median avicularium is triangular, salient, oblique; its orifice is disposed laterally. Often two adventitious avicularia hide the frontal more or less.

*Affinities.*—This small species is quite fragile and of a disconcerting irregularity. The very special arrangement of the avicularium, which opens on the side in a very *oblique* manner, is characteristic of the species. The rarity of the specimens has not permitted us to make a careful study, but we have thought it worth while to call the species to the attention of collectors.

*Occurrence.*—Lower Jacksonian: Three and one-half miles southeast of Shell Bluff post office, Georgia (rare).

*Holotype.*—Cat. No. 63852, U.S.N.M.

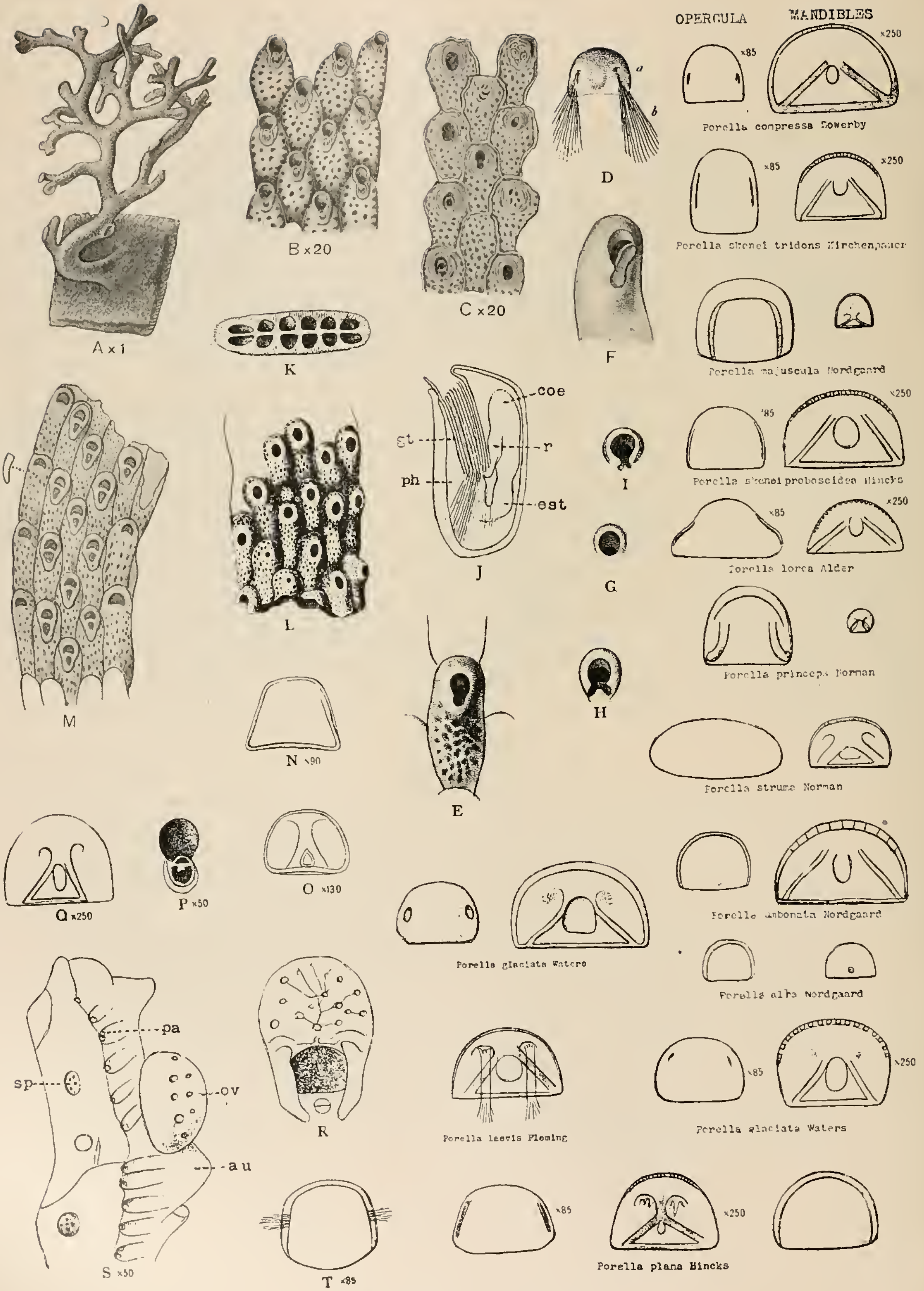
OPERCULA
MANDIBLES
A x1
B x20
C x20
D
a
b
F
K
Porella compressa Sowerby
x85
x250
Porella skenei tridens Kirchenpauer
Porella majuscula Nordgaard
Porella skenei proboscidea Hincks
Porella lorca Alder
Porella princeps Norman
Porella struma Norman
Porella umbonata Nordgaard
Porella alba Nordgaard
Porella glaciata Waters
Porella laevis Fleming
Porella plana Hincks
M
L
coe
gt
r
ph
est
J
I
G
H
E
N x90
O x130
P x50
Q x250
pa
sp
ov
au
R
S x50
T x85

FIG. 136.—Genus *Porella* Gray, 1848.

FIG. 136.—Genus *Porella* Gray, 1848.

A–Q. *Porella cervicornis* Pallas, 1766. A. Zoarium, natural size. B. Zooecia with median avicularia, × 20. C. Calcified zooecia, × 20. (A–C after Calvet, 1904.) D. Operculum with its occlusor muscles. E–I. Different forms of the peristomice. J. Anatomy of a zooecium. (D–J after Milne-Edwards, 1838.) *coc*, caecum of the stomach; *cst*, stomach; *gt*, tentacular sheath; *ph*, pharynx; *r*, rectum. K. Transversal section. L. Ovicelled zooecia. M. A fossil form of frequent occurrence. (K–M after Manzoni, 1877.) N, O. Operculum, × 50, and avicularian mandible, × 130. (After Calvet 1900.) P. Q. Orifice, × 50, and avicularian mandible, × 250. (After Waters, 1902.)

R–T. *Porella propinqua* Smitt, 1867. R. Relative arrangement of the ovicell, peristomie, and median avicularium. S. Lateral view of a zooecium, × 50. *au*, avicularian umbo; *ov*, ovicell; *pa*, areolar pore; *sp*, lateral septula. T. Operculum, × 85, showing a special occurrence of the occlusor muscles. (R–T after Nordgaard, 1905.)

### PORELLA IRREGULARIS, new species.

Plate 62, figs. 18–21.

*Description.*—The zoarium incrusts shells and bryozoa. The zooecia are distinct, elongated and of irregular form, separated by a furrow; the frontal is convex and formed of a tremocyst with numerous irregular pores. The apertura is visible at the base of the peristomie; the peristome is thin, oval, salient. The ovicell is globular, somewhat salient, little imbedded in the distal zooecia; it is hyperstomial and opens into the peristomie above the apertura; it is formed of a large area very finely porous, surrounded by a small, very little salient collar. The oral avicularium is median, placed in the sinus of the peristome, little salient, smooth.

*Measurements.*—Peristomice $\left\{\begin{array}{l} hpe=0.06\text{–}0.08 \text{ mm.} \\ lpe=0.12 \text{ mm.} \end{array}\right.$ Zooecia $\left\{\begin{array}{l} Lz=0.55\text{–}0.65 \text{ mm.} \\ lz=0.35\text{–}0.25 \text{ mm.} \end{array}\right.$

*Variations.*—The zooecia are quite *variable* in their form and in their micrometric dimensions even in the zoarial regions distant from the ancestrula (figs. 19, 20). In the interior (fig. 21) the small lyrula is visible. Figure 18 shows numerous traces of incompletely developed ovicells; there are some semicircular olocystal traces on the distal zooecia. The formation of the ovicell is therefore much posterior to that of the zooecia; it probably ought to coincide with the maturity of the ovary, as Jolliet thought in 1877.[1] But what is the origin of the endocystal bud which secretes the ovicellarian olocyst?

*Affinities.*—This species differs from *Porella granulosa* in its polygonal tremopores and its irregular zooecia.

It differs from *Porella coronata* in the absence of all adventitious avicularia.

*Occurrence.*—Lower Jacksonian (Moodys marl): Jackson, Mississippi (common).

*Cotypes.*—Cat. No. 64145, U.S.N.M.

### PORELLA GRANULOSA, new species.

Plate 62, fig. 13.

*Description.*—The zoarium incrusts bryozoa. The zooecia are distinct elongated, elliptical; the frontal is convex, granulose, and formed by a tremocyst with numerous pores, separated by prominent *granulations*. The apertura is semilunar and scarcely visible exteriorly; the peristome is thin, somewhat salient, semilunar, deformed below by the avicularium. The ovicell is globular, little salient, somewhat imbedded in the distal zooecia; it is formed of a large area, very finely porous, surrounded by a smooth or granulose collar; it is hyperstomial and opens into the peristomie above the apertura. The avicularium is very little salient; it deforms the peristome and opens into the peristomie.

*Measurements.*—Peristomice $\left\{\begin{array}{l} hpe=0.07 \text{ mm.} \\ lpe=0.12 \text{ mm.} \end{array}\right.$ Zooecia $\left\{\begin{array}{l} Lz=0.45 \text{ mm.} \\ lz=0.30 \text{ mm.} \end{array}\right.$

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[1] Jolliet, Contributions á l' historie naturelle des cotes de France, Archives de Zoologie experimental et generale, Paris, 1877, p. 75.

*Affinities.*—One may follow, from the zoarial extremity, the formation of the avicularium. In the peristomial sinus first formed there develops a small avicularium which increases and is transformed in small, somewhat salient chambers.

This species differs from *Porella irregularis* in the frontal granulations and the regular form of the zooecia.

*Occurrence.*—Lower Jacksonian (Moodys marl): Jackson, Mississippi (very rare).

*Holotype.*—Cat. No. 64142, U.S.N.M.

### PORELLA CORONATA, new species.

Plate 62, figs. 15–17.

*Description.*—The zoarium incrusts bryozoa. The zooecia are somewhat elongated, little distinct,, rather irregular; the frontal is convex and formed of a tremocyst with large pores in quincunx. The apertura is little visible at the base of a deep peristomie; the peristome is thin, salient, garnished with 1 to 5 small, round avicularia; the lyrula is very small and supports a median avicularium. The ovicell is large, transverse but little salient; it is formed of a large area finely porous and very fragile, surrounded by a little salient collar. The median avicularium is very little salient, opening outward and borne on a small lyrula. Sometimes there are some small adventitious lateral avicularia.

*Measurements.*—Peristomice $\begin{cases} hpe=0.10 \text{ mm.} \\ lpe=0.14 \text{ mm.} \end{cases}$ Zooecia $\begin{cases} Lz=0.60 \text{ mm.} \\ lz=0.30 \text{ mm.} \end{cases}$

*Variations.*—The young zooecia (fig. 15) or marginal zooecia are separated by a prominent thread; their avicularium is buried in the peristomie, and the avicularia of the peristome are very small. On the adult zooecia the avicularia of the peristome form a sort of *crown* around the apertura; but their number is quite variable and the formation of the ovicell causes them to disappear (fig. 16); they have a pivot. The frontal of the ovicell is very fragile; its absence complicates still more the very irregular aspect of this species.

*Affinities.*—This species differs from *Porella irregularis* and *Porella granulosa*, which also have incrusting zoaria, in the presence of the avicularia on the peristome.

*Occurrence.*—Lower Jacksonian (Moodys marl): Jackson, Mississippi (rare). Middle Jacksonian (Castle Hayne limestone); Wilmington, North Carolina (very rare).

*Cotypes.*—Cat. No. 64144, U.S.N.M.

### PORELLA DENTICULIFERA, new species.

Plate 63, figs. 1–5.

*Description.*—The zoarium is bilamellar: the two lamellae are back to back and separable. The zooecia are indistinct: the frontal is little convex and formed of a tremocyst, with pores enormous and little numerous. The apertura (in the interior) is semicircular and quite oblique with a proximal border somewhat concave; the peristomice has the form of a trapezoid; the peristome is absent. The ovicell is small, entirely imbedded in the distal zooecium, not salient; its frontal is perforated with numerous small pores. The median avicularium is rather large, smooth; it makes a prominence in the peristomie in the form of a *denticulated* tube with its distal part.

*Measurements.*—Peristomice $\left\{\begin{array}{l} hpe=0.13 \text{ mm.} \\ lpe=0.15 \text{ mm.} \end{array}\right.$ Zooecia $\left\{\begin{array}{l} Lz=0.65\text{–}0.70 \text{ mm.} \\ lz=0.35 \text{ mm.} \end{array}\right.$

*Affinities.*—Under the microscope it is rather easy to instinctively separate this species from *Porella jacksonica*, but upon analysis it is difficult to find the clearly separating characters. It appears to differ from it in the small denticles which often terminate the median avicularium and in the size and rarity of the tremopores.

The tangential section (fig. 5) is that of a tremocyst resting on an olócyst; the ovicell is here confounded naturally with the peristomie.

The tremopores are tubular and as long as the thickness of the zooecium.

*Occurrence.*—Claibornian (Gosport sand): One mile southwest of Rockville, Alabama.

Lower Jacksonian (Moodys marl): Jackson, Mississippi (common).

*Cotypes.*—Cat. No. 64146, U.S.N.M.

## PORELLA JACKSONICA, new species.

Plate 63, figs. 6–17.

*Description.*—The zoarium is bilamellar, formed of two lamellae, back to back, difficultly separable; the fronds are flat or undulated. The zooecia are distinct, very elongated, fusiform; the frontal is convex and terminated distally by an enormous, oblique avicularian mucro making a projection at 45° and covering in part the apertura; the frontal is formed by a tremocyst with large tubular pores resting on a thin perforated olocyst. The apertura is transverse, semilunar, oblique, buried at the base of the peristomie. The peristome is not salient. The ovicell is entirely imbedded in the walls of the distal zooecia and is not salient; its frontal area is pierced with pores and very fragile. The median avicularium is smooth, enormous, very salient; it opens on the side of the apertura. There are some small, inconstant adventitious avicularia formed by the coalescence of two tremopores.

*Measurements.*—Peristomice $\left\{\begin{array}{l} hpe=0.10 \text{ mm.} \\ lpe=0.10\text{–}0.12 \text{ mm.} \end{array}\right.$ Zooecium $\left\{\begin{array}{l} Lz=0.54\text{–}0.80 \text{ mm.} \\ lz=0.24\text{–}0.30 \text{ mm.} \end{array}\right.$

*Variations.*—This species is of a disconcerting irregularity and it is with much trouble that we have been able to assemble the various forms which appear at first sight absolutely distinct. The irregularity arises chiefly from the alteration during fossilization, as is the habit in the species with great relief; the breaking of the median avicularium, the obliteration of the tremopores, and the rupture of the avicularian area are other causes which give to the specimens absolutely divergent aspects. Their illumination even under the microscope changes their aspect; the illumination from below is preferable. The most usual aspects are those of the figures 7–10, 13. Finally the species which is quite vigorous in the lower Jacksonian ($Lz$=0.70–0.80 mm.) appears to become stunted in the middle and upper Jacksonian ($Lz$=0.54–0.60 mm.) (fig. 16). The zooecia are not always distinct (figs. 10, 16).

In the interior (fig. 15) the tubules are well marked by the white circle which surrounds the small pores of the olocyst. Moreover, there is a short lyrula and two small cardelles (fig. 15).

This species has been found in many localities of the Jacksonian, which fact occasions its name.

*Occurrence.*—Lower Jacksonian (Moodys marl): Jackson, Mississippi (very common).

Middle Jacksonian: Wilmington, North Carolina (common); Baldock, Barnwell County, South Carolina (rare).

Jacksonian (Zeuglodon zone): South side of Suck Creek, Clarke County, Mississippi (very rare); Shubuta, Mississippi (rare).

Upper Jacksonian (Ocala limestone): Alachua, Florida (rare).

*Cotypes.*—Cat. Nos. 64147–64150, U.S.N.M.

### PORELLA PUNGENS, new species.

Plate 62, fig. 14.

*Description.*—The zoarium incrusts oysters. The zooecia are distinct; quite elongated, fusiform, separated by a deep furrow; the frontal is convex, formed of a tremocyst, with four rows of large scattered pores. The apertura is hidden at the base of the peristomie by the median avicularium; the peristome is very thin and somewhat salient. The ovicell is large, globular, salient, formed of an area with numerous small pores surrounded by a smooth collar. The median avicularium is enormous, very salient; elevated obliquely at 45°; it covers in part the apertura and opens on its side.

*Measurements.*—Peristomice $\begin{cases} hpe=0.08 \text{ mm.} \\ lpe=0.10 \text{ mm.} \end{cases}$ Zooecia $\begin{cases} Lz=0.70\text{–}0.80 \text{ mm.} \\ lz=0.26\text{–}0.30 \text{ mm.} \end{cases}$

*Affinities.*—This species differs from the incrusting species, such as *Porella granulosa*, *Porella irregularis*, and *Porella coronata*, in its enormous and salient median avicularium.

Its aspect is similar to *Porella jacksonica*, of which it is perhaps only the incrusting form. It differs from it nevertheless in its avicularium still more elevated and its salient ovicell, little imbedded in the distal zooecium. It differs from *Lepralia monoceros* Reuss, 1847, and *Lepralia ceratomorpha* Reuss, 1847, of the European Miocene, in the presence of tremopores and not of areolae. The zoarium appears to be bristling with sharp points.

*Occurrence.*—Lower Jacksonian (Moodys marl): Jackson, Mississippi (common).

*Holotype.*—Cat. No. 64143, U.S.N.M.

### PORELLA UNGUICULATA, new species.

Plate 64, figs. 1–5.

*Description.*—The zoarium is unilamellar and creeps on algae. The zooecia are distinct, elongated, fusiform; the frontal is convex and is terminated distally by a long *ungulate* mucro covering the apertura; it is formed of a tremocyst with scattered pores, disposed in quincunx. The apertura is invisible exteriorly; the peristome is wanting. The ovicell is hardly salient; the pores of the area are much smaller than those of the frontal; it is hyperstomial and opens into the peristomie. The median avicularium is large, oblique, smooth, totally burying the apertura.

*Measurements.*—Zooecia $\begin{cases} Lz = 0.72 \text{ mm.} \\ lz = 0.37 \text{ mm.} \end{cases}$

*Affinities.*—This species much resembles *Porella jacksonica*, of which it is perhaps the creeping form. It differs from it in its smaller tremopores, the exaggerated length of its median avicularium, which always covers the apertura on the well preserved specimens, and in the absence of all adventitious avicularia.

In the interior (fig. 5) the olocyst is thick; the proximal border of the apertura is convex; the mucro is visible.

On the zoarial margins the avicularium is more fragile and more easily broken (fig. 3).

*Occurrence.*—Middle Jacksonian (Castle Hayne limestone): Wilmington, North Carolina (common).

*Cotypes.*—Cat. No. 64151, U.S.N.M.

### PORELLA PLANULATA, new species.

Plate 64, figs. 6–9.

*Description.*—The zoarium is bilamellar and formed of two lamellae, back to back and inseparable. The zooecia are distinct, elongated, rounded in front, narrowed behind, separated by a salient thread; the frontal is *flat* and formed of a tremocyst with large tubules resting on an olocyst with small pores. The apertura (in the interior) is formed of a semilunar anter and of a very concave poster; at the exterior the peristomice is elliptical and the peristome very thin. The median avicularium is very small, buried in the thickness of the tremocyst and opens into the peristomie; it is visible only by abrasion of the surface. Sometimes avicularian zooecia are intercalated among the normal zooecia.

*Measurements.*—Peristomice $\begin{cases} hpe = 0.22 \text{ mm.} \\ lpe = 0.18 \text{ mm.} \end{cases}$ Zooecia $\begin{cases} Lz = 0.90\text{–}1.10 \text{ mm.} \\ lz = 0.40\text{–}0.45 \text{ mm.} \end{cases}$

*Affinities.*—This grand and beautiful species is remarkable, but we still possess no specimen with an ovicell. The median avicularium is absolutely invisible exteriorly; by properly inclining the preparation its orifice is visible; upon abrasion of the surface it appears like a small cavity in the thickness of the tremocyst (fig. 9).

In the interior certain zooecia are divided in two parts by a partition, of whose use we are absolutely ignorant (fig. 8).

Finally, the avicularian zooecia are rather frequent: they are characterized by a very large opening, narrowed in its median part. We know that the operculum is replaced there by a mandible and that the polypide has disappeared by histolysis.

*Occurrence.*—Middle Jacksonian (Castle Hayne limestone): Wilmington, North Carolina (rare); near Lenuds Ferry, South Carolina (rare).

*Holotype.*—Cat. No. 64152, U.S.N.M.

### **PORELLA ABDITA**, new species.

Plate 65, figs. 1–3.

*Description.*—The zoarium is large, bilamellar, and formed of two lamellae, back to back, and inseparable. The zooecia are indistinct: the frontal is convex and formed of a tremocyst with irregular pores. The peristomice is orbicular or elliptical. The median avicularium is very small, buried in the thickness of the tremocyst, opening in the peristomie, *hardly* visible exteriorly. Often a small adventitious avicularium is placed in the vicinity of the peristomice.

*Measurements.*—Peristomice $\left\{\begin{array}{l} hpe=0.20 \text{ mm.} \\ lpe=0.15 \text{ mm.} \end{array}\right.$ Zooecia $\left\{\begin{array}{l} Lz=0.70\text{–}0.75 \text{ mm.} \\ lz=0.30\text{–}0.35 \text{ mm.} \end{array}\right.$

*Affinities.*—We have collected only a small number of specimens and it is possible, therefore, that they are related to another species of which they may be the strongly calcified representatives. This is, in fact, the habitual variation in *Porella denticulifera* and *Porella jacksonica*. To be certain of the identification with the latter species it will be necessary to find a greater number of specimens in the same localities.

*Occurrence.*—Upper Jacksonian (Ocala limestone): Alachua, Florida (rare); 9 miles north of Ocala, Florida (rare).

*Cotypes.*—Cat. Nos. 64154, 64155, U.S.N.M.

### **PORELLA PORTENTOSA**, new species.

Plate 64, figs. 10–23.

*Description.*—The zoarium is bilamellar; the fronds are flat or a little undulated. The zooecia are distinct, quite elongated, tubular; the frontal is convex and formed of a tremocyst with large tubular pores, supported by a very thin, perforated olocyst; the tubules have thick walls and are separated from one another. The apertura is semilunar, with the proximal border convex; the peristome is very thin, hardly salient. The ovicell is much embedded in the distal zooecium, hardly prominent; its frontal is a perforated area; the ovicell is hyperstomial and opens into the peristomie. The avicularium is placed entirely within the peristomie.

*Measurements.*—Peristomice $\left\{\begin{array}{l} hpe=0.11 \text{ mm.} \\ lpe=0.12 \text{ mm.} \end{array}\right.$ Zooecia $\left\{\begin{array}{l} Lz=0.80\text{–}0.90 \text{ mm.} \\ lz=0.26 \text{ mm.} \end{array}\right.$

*Variations.*—This species is quite *remarkable*. The tubules are not adjacent and are separated from each other: this results in the frontal having a fantastic aspect which is impossible to describe. When these tubules are adjacent (figs. 11,

12) the determination remains rather difficult, and it is necessary to assemble a considerable number of specimens to make it. The thickness of the walls of the tubules is quite visible on the tangential sections (fig. 23). Their length is visible on the transversal sections, which aré always difficult to make on account of the irregularity of the frontal network. The olocyst is perforated with very small pores corresponding to the superposed tremopores (fig. 21).

*Occurrence.*—Middle Jacksonian: Baldock, Barnwell County, South Carolina (very common); Rich Hill, Crawford County, Georgia (common); 18 miles west of Wrightsville, Georgia (common).

Upper Jacksonian (Ocala limestone): Alachua, Florida (rare).

*Cotypes.*—Cat. No. 64153, U.S.N.M.

### PORELLA CRASSOPARIES, new species.

Plate 95, figs. 10–21.

*Description.*—The zoarium is hollow, cylindrical, branched, unilamellar; it incrusts small algae. The zooecia are distinct, elongated, tubular; the frontal is convex and formed of a *thick* tremocyst with large tubules placed on a very thin perforated olocyst. The apertura is semilunar, very oblique, situated at the base of a deep peristomie; the peristome is thin or thick, hardly salient, interrupted in front. The ovicell is salient, globular, of the same nature as the frontal; it is hyperstomial and opens into the peristomie. The median avicularium is sunk in the thickness of the tremocyst; it opens into the peristomie where it often forms a tubular prominence.

*Measurements.*—Apertura (interior) $\begin{cases} ha=0.12\text{ mm.} \\ la=0.15\text{ mm.} \end{cases}$ Peristomice (exterior) $\begin{cases} hpe=0.20\text{ mm.} \\ lpe=0.14\text{ mm.} \end{cases}$

Zooecia $\begin{cases} Lz=0.64\text{–}0.70\text{ mm.} \\ lz=0.36\text{–}0.44\text{ mm.} \end{cases}$

*Variations.*—The great variations of this species evidently depend on the thickness of the tremocyst. The young zooecia (fig. 12) are bordered and appear smaller. The old zooecia (figs. 13, 14) appear larger; the avicularium is there little visible (fig. 13), and even invisible (fig. 14); the great thickness of the frontal may be seen in the transversal sections (fig. 21) and in the longitudinal sections (figs. 15–17), where the tremopores are transformed into very long tubules.

In the interior the lateral walls are very thin (fig. 18); the avicularium is only visible there as a small convexity below the apertura. The abrasion of the olocyst (fig. 19) shows that it is very small.

Figure 20, though badly oriented is however very interesting. On top the section is in the tremocyst and the pores are white. Below the section is in the olocyst for the pores are closed. The black rings indicate the section; on some pores we see the small pore which perforates the olocyst in the middle of the large ring formed by the tremopore.

The zoarium may be formed of many superposed lamellae (fig. 15).

*Affinities.*—This species differs from *Porella abdita* in its distinct zooecia and in its zoarium creeping over algae and not bilamellar.

In its exterior aspect and in the nature of its zoarium it may be easily confounded with *Cyclicopora spongiopsis* De Gregorio, 1882. It differs from it in the regular and constant presence of the median avicularium.

*Occurrence.*—Vicksburgian (Marianna limestone): West Bank Conecuh River, Escambia County, Alabama (common): Murder Creek, east of Castlebury, Conecuh County, Alabama (common); Claiborne, Monroe County, Alabama (common):

*Cotypes.*—Cat. No. 64308, U.S.N.M.

### PORELLA CYLINDRICA, new species.

Plate 94, figs. 14–17.

*Description.*—The zoarium is free, *cylindrical*, bifurcated, formed by four to six longitudinal rows of zooecia. The zooecia are distinct, elongated, separated by a salient thread; the frontal is somewhat convex and is formed of a thick tremocyst with large tubules. The apertura is deep and partially hidden by the median avicularium: it has no peristome. The median avicularium is enormous, very salient, very straight with an orifice turned toward the side of the apertura.

*Measurements.*—Apertura $\left\{\begin{array}{l} ha = ?\text{ mm.} \\ la = 0.11\text{ mm.} \end{array}\right.$ Zooecia $\left\{\begin{array}{l} Lz = 0.85\text{ mm.} \\ lz = 0.40\text{ mm.} \end{array}\right.$

*Affinities.*—The vincularian form of its zoarium clearly distinguishes this species from the species with large median avicularium, such as *Porella denticulifera*, *Porella jacksonica*, *Porella pungens*, and *Porella unguiculata*.

*Occurrence.*—Vicksburgian ("Chimney rock" of Marianna limestone): One mile north of Monroeville, Alabama (common).

*Cotypes.*—Cat. No. 64304, U.S.N.M.

### PORELLA ERECTA, new species.

Plate 93, figs. 17–20.

*Description.*—The zoarium is free, bilamellar, formed of two lamellae, back to back, and inseparable; the fronds are narrow and bifurcated.

The zooecia are distinct, long, tubular; the frontal is convex and formed of a tubular tremocyst placed on a thin olocyst with small pores. The apertura is semilunar, oblique, buried, by the umbo when the latter is entire; it has no peristome. The ovicell is globular, salient, with a finely porous area; it is hyperstomial and opens into the peristomie. The median avicularium forms a very salient umbo little oblique above the aperture, almost *erect*, very thin, and very fragile at the extremity.

*Measurements.*—Peristomice $\left\{\begin{array}{l} hpe = 0.16\text{ mm.} \\ lpe = 0.16\text{ mm.} \end{array}\right.$ Apertura (interior) $\left\{\begin{array}{l} ha = 0.08\text{ mm.} \\ la = 0.10\text{ mm.} \end{array}\right.$

Zooecia $\left\{\begin{array}{l} Lz = 0.70\text{ mm.} \\ lz = 0.44\text{ mm.} \end{array}\right.$

*Variations.*—This species is not very variable in itself, but the frontal avicularium is so fragile that the fossils are generally deprived of it; it is replaced by a large irregular cicatrix.

*Affinities.*—This species is rather close to *Porella jacksonica.* It differs from it in its much less oblique avicularium, its smaller tremopores, and its zoarial fronds much less wide and containing only from five to six longitudinal rows of zooecia at most.

The young fronds differ from *Porella cylindrica* in its nonbordered, cylindrical zooecia and in its smaller tremopores.

It differs from *Porella compacta,* in which the zoarial fronds are identical, in the thinness of the avicularium and in its more numerous and much smaller tremopores.

*Occurrence.*—Vicksburgian (Red Bluff clay): Seven and one-half miles southwest from Bladen Springs, Alabama (rare).

*Cotypes.*—Cat. No. 64301, U.S.N.M.

### PORELLA COMPACTA, new species.

Plate 94, figs. 12, 13.

*Description.*—The zoarium is free, bilamellar, formed of two lamellae, back to back, and easily separable; the fronds are very narrow and bifurcated. The zooecia are distinct, somewhat elongated, wide; the frontal is convex and formed of a tremocyst with tubules coalesced into very large tremopores, placed on an olocyst with numerous small pores. The apertura (interior) is elongated, semilunar, oblique; it has no salient peristome. The ovicell is very small, not salient, ornamented also with large tremopores. The avicularium forms an enormous umbo, large, short, *thickset,* oblique, hiding a part of the aperture, costulated longitudinally.

*Measurements.*—Peristomice $\begin{cases} hpe=0.16 \text{ mm.} \\ lpe=0.14 \text{ mm.} \end{cases}$ Apertura (interior) $\begin{cases} ha=0.12 \text{ mm.} \\ la=0.10 \text{ mm.} \end{cases}$

Zooecia $\begin{cases} Lz=0.50\text{–}0.60 \text{ mm.} \\ lz=0.22\text{–}0.24 \text{ mm.} \end{cases}$

*Variations.*—In the interior the zooecial width (0.22–0.24 mm.) is evidently smaller than the exterior (0.30 mm.).

There is no correspondance between the number of perforations of the olocyst (10 to 12) and the large exterior pores (5 and 6); that is, in fact, in their commonage, the tubules become confluent and reunite among themselves.

The mandible of the median avicularium is small, semicircular; it is placed at the extremity of the umbo and turned toward the apertura.

*Affinities.*—This species differs from *Porella erecta,* in which the fronds are identical, in its umbo, which is large and short and not long and thin and its much larger tremopores.

It differs from *Porella jacksonica* in its zoarial fronds not spread out and very narrow, in its much wider umbo and in its still larger tremopores.

*Occurrence.*—Vicksburgian (Byram marl): Byram, Mississippi (very rare); one-fourth mile west of Woodward, Wayne County, Mississippi (common).

*Holotype.*—Cat. No. 64303, U.S.N.M.

*Geological distribution of American species of Porella.*

| Name. | Claibornian. | Jacksonian. | | | | Vicksburgian. |
|---|---|---|---|---|---|---|
| | | Lower Jacksonian. | Middle Jacksonian. | | Upper Jacksonian. | |
| | | | Wilmington zone. | Rich Hill zone. | | |
| *Porella obliqua*, new species | | + | | | | |
| *Porella irregularis*, new species | | + | | | | |
| *Porella granulosa*, new species | | + | | | | |
| *Porella coronata*, new species | | + | + | | | |
| *Porella portentosa*, new species | | | | + | + | |
| *Porella denticulifera*, new species | + | + | | | | |
| *Porella jacksonica*, new species | | + | + | + | + | |
| *Porella pungens*, new species | | + | | | | |
| *Porella unguiculata*, new species | | | + | | | |
| *Porella crassoparies*, new species | | | | | | + |
| *Porella abdita*, new species | | | | | + | |
| *Porella planulata*, new species | | | + | | | |
| *Porella cylindrica*, new species | | | | | | + |
| *Porella erecta*, new species | | | | | | + |
| *Porella compacta*, new species | | | | | | + |

ANALYTICAL KEY TO AMERICAN SPECIES OF PORELLA.

| | | |
|---|---|---|
| 1 | Zoarium vincular | *Porella cylindrica.* |
| | Zoarium incrusting | 2 |
| | Zoarium escharian | 5 |
| | Zoarium unilamellar | 10 |
| 2 | Avicularium median, triangular | *Porella obliqua.* |
| | Avicularium quite salient on umbo | *Porella pungens.* |
| | Avicularium little salient | 3 |
| 3 | Avicularium adventitious on the peristome | *Porella coronata.* |
| | Avicularium not adventitious on the peristome | 4 |
| 4 | Frontal granular | *Porella granulosa.* |
| | No granules, zooecia irregular | *Porella irregularis.* |
| 5 | Avicularium median, very salient on umbo | 6 |
| | Avicularium small, not salient | 8 |
| 6 | Umbo nearly straight | *Porella erecta.* |
| | Avicularian umbo oblique | 7 |
| 7 | Avicularian umbo large and short | *Porella compacta.* |
| | Avicularian umbo thin, denticulate, very large tremopores | *Porella denticulifera.* |
| | Avicularian umbo thin, tremopores | *Porella jacksonica.* |
| 8 | Large zooecia (Lz=1.10 mm.), avicularia invisible | *Porella planulata.* |
| | Smaller zooecia | 9 |
| 9 | Frontal with separated tremopores | *Porella portentosa.* |
| | Frontal with adjacent tremopores; avicularia hardly visible | *Porella abdita.* |
| 10 | Large avicularian umbo very salient | *Porella unguiculata.* |
| | Avicularium not salient, small | *Porella crassoparies.* |

## Genus UMBONULA Hincks, 1880.

1880. *Umbonula* Hincks. British Marine Polyzoa, p. 316.

There is neither lyrula nor cardelles. The apertura is suborbicular. The ovicell is hyperstomial and opens largely above the apertura. The frontal is a pleurocyst with costules surrounded by areolae. A prominent umbo immediately below the mouth supporting an avicularium. 20–30 tentacles.

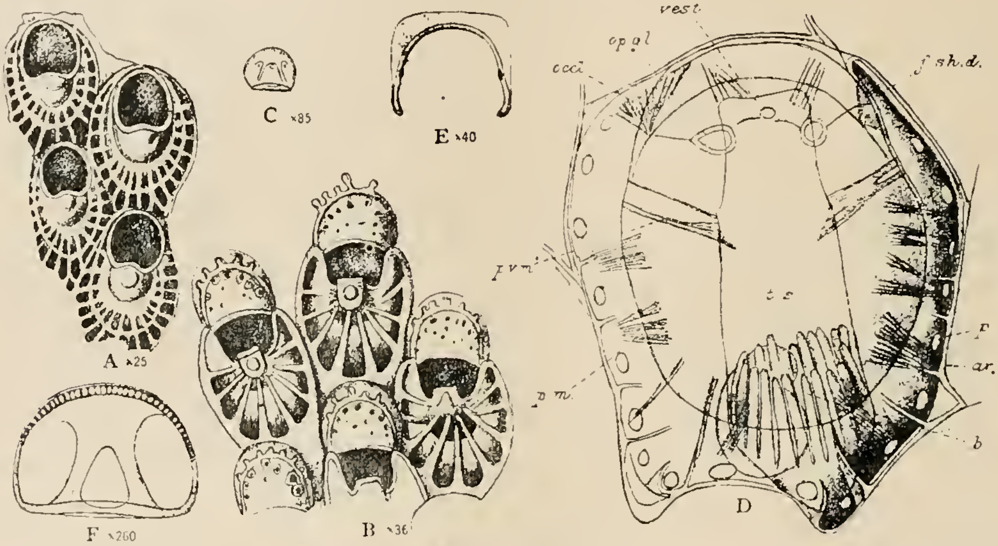


Fig. 137.—Genus *Umbonula* Hincks, 1880.

A–D. *Umbonula verrucosa* Esper. 1791. A. Ordinary zooecia. × 25. B. Ovicelled zooecia. × 36. (A, B after Hincks, 1880.) C. Avicularian mandible, × 85. (After Waters, 1885.) D. Young zooecium. The frontal shield is represented by a crescentic calcareous film, already divided by radiating buttresses on the upper surface into distinct areolae (*ar*) in the floor of each of which is a pore (*p*). The distal wings (*f. sh. d*) of the shield are distinctly indicated. The parietal muscles (*p. m.*) are seen through the calcareous film. *pvm*, parieto-vaginal muscles. (After Harmer, 1902.) *vest*, vestibulum; *op. gl.*, opercular glands; *occl*, occlusor muscles of the operculum; *t. s.*, tentacular sheath; *b*, polypide bud. E. Operculum, × 40. F. Avicularian mandible, × 260. (E, F after Calvet, 1903.)

*Genotype.*—*Umbonula* (*Cellepora*) *verrucosa* Esper. 1791.

*Range.*—Lutetian-Recent.

The ovicell is analogous to that in *Rhamphostomella* Lorenz, 1896, but there is no lyrula. It has not a deep peristomie as in *Porella* and *Smittina*, into which the ovicell opens. The place of this genus in this family is doubtful. Harmer in 1902 considered it as the type of a special family.

### UMBONULA (?) MISER, new species.

Plate 94, fig. 19.

*Description.*—The zoarium is unilamellar and creeps on algae. The zooecia are elongated, distinct, quite irregular, little symmetrical, of an ugly aspect; the frontal is convex, formed of a smooth pleurocyst surrounded by small triangular areolae. The peristome is thick, irregular, hardly salient. The ovicell is small, little prominent; it is hyperstomial and opens into the peristomie. The median avicularium is small, little salient; it deforms the peristomice inferiorly.

*Measurements.*—Peristomice $\begin{cases} hpe=0.10 \text{ mm.} \\ lpe=0.10 \text{ mm.} \end{cases}$ Zooecia $\begin{cases} Lz=0.44 \text{ mm.} \\ lz=0.24\text{–}0.30 \text{ mm.} \end{cases}$

*Affinities.*—The aspect of this species is *lamentable;* without grace or elegance, it can not compare with any of the elegant Vicksburgian species.

It differs from *Umbonula ceratomorpha* Reuss, 1847, in its smaller dimensions ($Lz=0.44$ and not 0.60 mm.) and in its much smaller areolae.

*Occurrence.*—Vicksburgian (Marianna limestone): Salt Mountain, 5 miles south of Jackson, Alabama (rare).

*Holotype.*—Cat. No. 64306, U.S.N.M.

### UMBONULA CERATOMORPHA Reuss, 1847.

Plate 94, fig. 18.

1847. *Cellepora ceratomorpha* Reuss, Die fossilen Polyparien des Wiener Tertiarbeckens, Haidinger's Naturwissenschaftliche Abhandlungen, vol. 2, p. 80, pl. 9, fig. 25.

1863. *Repteschareila cornuta* Römer, Beschreibung der norddeutschen tertiären Polyparien, Paleontographica, vol. 9, p. 212, pl. 36, fig. 6.

1874. *Lepralia ceratomorpha* Reuss, Die fossilen Bryozoen des Oesterreichisch-Ungarischen Miocäns, Abth. 1, p. 35, pl. 3, figs. 6–8.

The bibliography of this species is rather confused, and as we have not at hand the data for a serious discussion, we can consider therefore only the published figures. Even in these narrow limits its cosmopolitanism is quite manifest.

Our American specimens are escharian, whereas the European specimens are incrusting. According to present ideas this character is not specific.

*Measurements.*—Peristomice $\begin{cases} hpe=0.16 \text{ mm.} \\ lpe=0.12 \text{ mm.} \end{cases}$ Zooecia $\begin{cases} Lz=0.60\text{–}0.70 \text{ mm.} \\ lz=0.30\text{–}0.34 \text{ mm.} \end{cases}$

*Occurrence.*—Vicksburgian (Marianna limestone): West bank of Conecuh River, Escambia County, Alabama (rare); Murder Creek, east of Castlebury, Conecuh County, Alabama (rare); Salt Mountain, 5 miles south of Jackson, Mississippi (rare).

Vicksburgian (Red Bluff clay): 7½ miles southwest from Bladen Springs, Alabama (very rare).

*Geological distribution.*—Chattian (Upper Tongrian) of Germany (Roemer): Tortonian of Austria Hungary (Reuss).

*Plesiotypes.*—Cat. No. 64305, U.S.N.M.

### Genus PHOCEANA Jullien, 1903.

1903. *Phoceana* Jullien, Bryozoaires provenant des Campagnes de *l'Hirondelle*, p. 107.

The apertura is semicircular with poster slightly concave; it is deprived of cardelles and bears a pseudolyrula formed by the elevation of the peristomial wall. The operculum bears a chitinous mural rim incomplete at the level of the convexity of the upper border and little removed from the lateral borders.

*Genotype.*—*Phoceana columnaris* Jullien, 1903.

*Range.*—Jacksonian—Recent.

### PHOCEANA (?) SIMULATOR, new species.

Plate 65, figs. 4–8.

*Description.*—The zoarium is free, cylindrical, never branched, and formed of four to five longitudinal rows of zooecia. The zooecia are indistinct; the frontal is little convex and smooth. The peristome is salient, entire or irregularly perforated; the peristomice is irregular, orbicular or elliptical, and transverse; the peristomie is deep, and the apertura is invisible.

*Measurements.*—Peristomice $\begin{cases} hpe=0.06\text{–}0.15 \text{ mm.} \\ lpe=0.18 \text{ mm.} \end{cases}$ Zooecia $\begin{cases} Lz=0.65\text{–}0.70 \text{ mm.} \\ lz=0.25 \text{ mm.} \end{cases}$

*Affinities.*—The pseudolyrula is visible only on the specimens with feeble peristomie (fig. 6). The longitudinal section of a zooecium (fig. 8) shows that the peristome often bears a small avicularium.

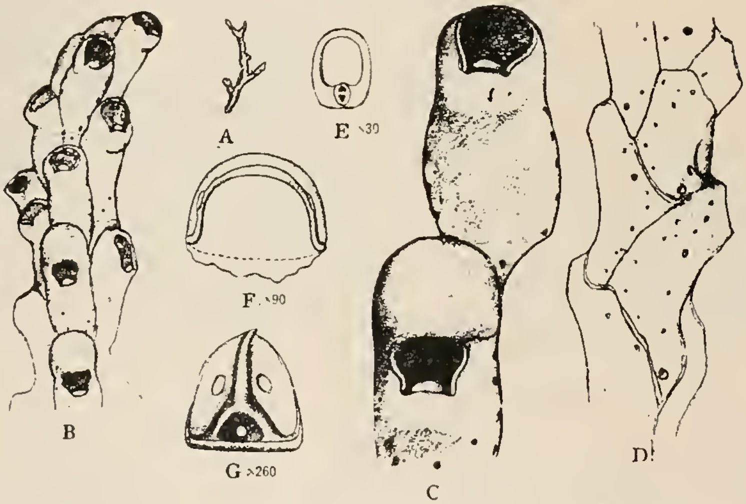


Fig. 138.—Genus *Bryocryptella* Cossman, 1906.

A–E. *Bryocryptella* (*Cryptella*) *torquata* Jullien, 1903. A. Zoarium natural size. B, C. Zoarium enlarged and two zooecia of same. D. Dorsal face of a zoarium. (A–D after Norman, 1909.) E. Zooecial orifice, × 30. (After Jullien, 1903.) F, G. *Bryocryptella koehleri* Calvet, 1896. Operculum, × 90, and avicularian mandible, × 260. (After Calvet, 1903.)

This species much resembles *Acropora asperula*, whose exterior aspect it *simulates* absolutely. It differs from it, however, in its smaller micrometric dimensions, in the absence of an ascopore, and in the presence of the peristomial pseudolyrula.

*Occurrence.*—Middle Jacksonian (Castle Hayne limestone): Wilmington, North Carolina (common).

*Cotypes.*—Cat. No. 64156, U.S.N.M.

### Genus BRYOCRYPTELLA Cossman, 1906.

1903. *Cryptella* Jullien, Bryozoaires provenant des Campagnes de *l'Hirondelle*, p. 76. (Preoccupied.)

1906. *Bryocryptella* Cossman, Revue critique paleozoologie, vol. 10, p. 196.

The ovicell is not closed by the operculum; it opens into the peristomie. The apertura is subquadrilateral, deprived of lyrula and cardelles. The frontal is a pleurocyst surrounded by a border of areolae, which often form a collar around the orifice. There is a median avicularium developed on the poster. The zoarium is escharoid, flattened and branched, formed of a single layer of zooecia.

*Genotype.—Cryptella torquata* Jullien, 1903. Recent.

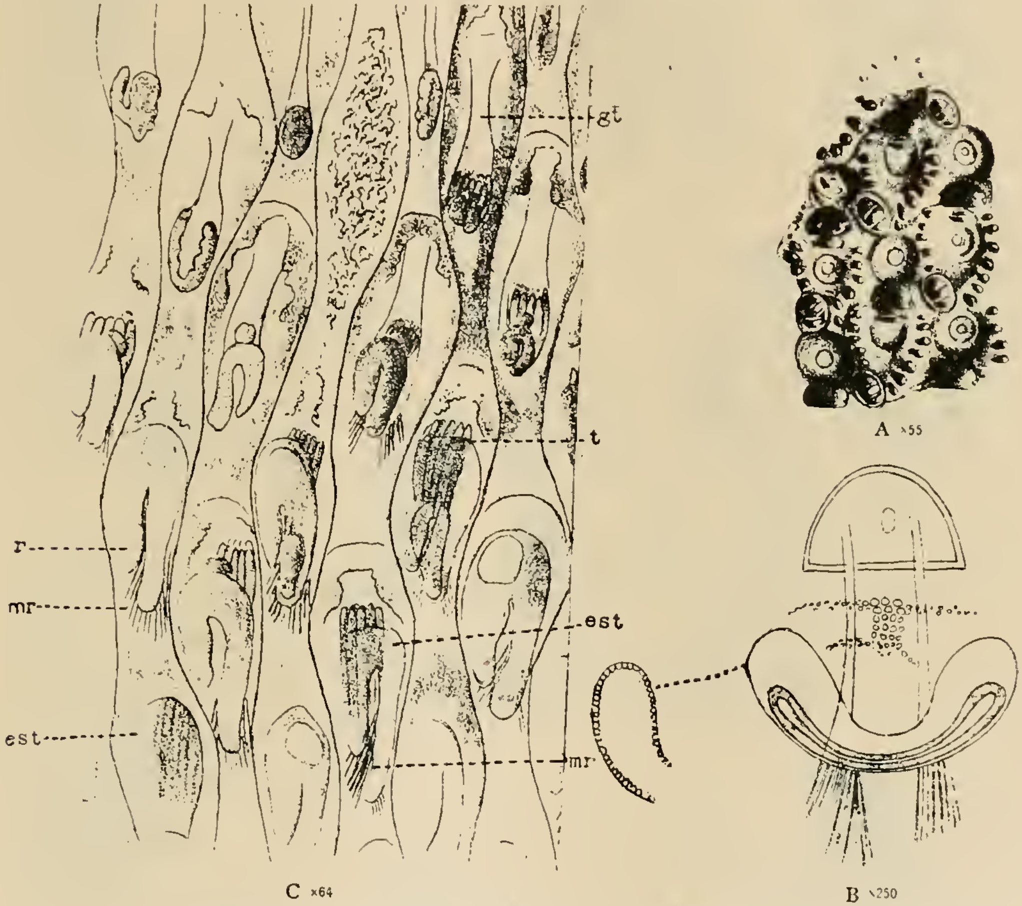


FIG. 139.—Genus *Hippadenella* Canu and Bassler, 1917.

A–C. *Hippadenella margaritifera* Quoy and Gaymard, 1833. A. Zooecia, × 55. The primary ribs of the frontal wall are seen at the bottom of the avicularia. Both the ovicells and the avicularian chambers show concentric deposits of lime, × 55. (After Levinsen, 1909.) B. Section exhibiting contents of avicularian chambers with double gland-like bodies and the protoplasmic mass and a section of the larger body, × 250. (After Waters, 1888.) C. Fragment of decalcified zoarium, × 64, seen from the dorsal face. The growth of the polypide from the young stage, figured in the upper part of the figure to the more advanced stages in the lower part, is exhibited. The stomach is enormous. (After Jullien, 1888.)

*est*, stomach; *gt*, tentacular sheath; *mr*, retractor muscles of polypide; *r*, rectum; *t*, tentacles.

### Genus HIPPADENELLA Canu and Bassler, 1917.

1917. *Hippadenella* CANU and BASSLER, Synopsis American Early Tertiary Cheilostome Bryozoa, Bulletin 96, United States National Museum, p. 54.

The frontal is a pleurocyst surrounded by areolae. The apertura bears two cardelles. The mandibles have a lucida in the middle. The avicularian chamber shows a double gland-like body and the protoplasmic mass.

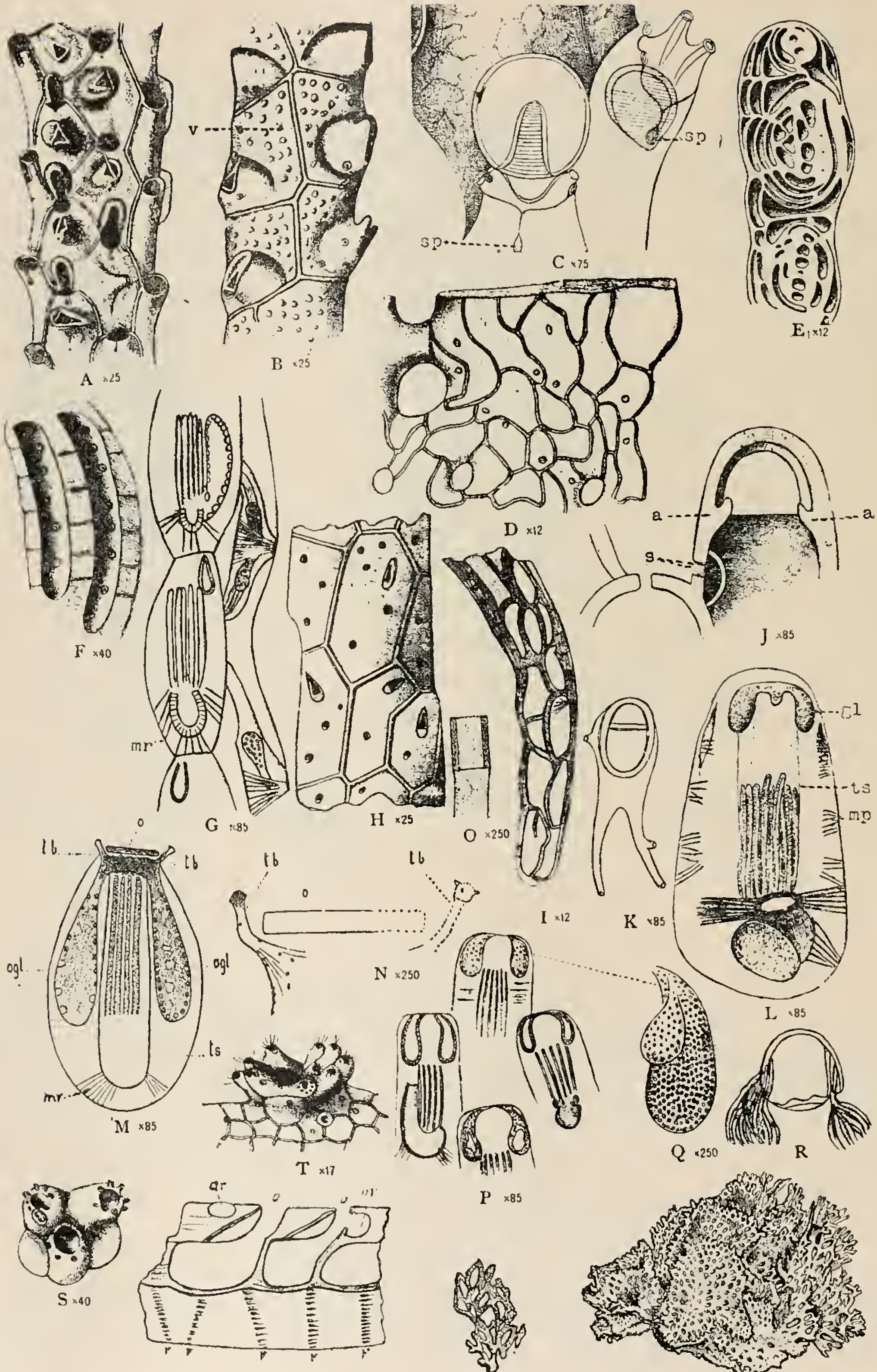

A ×25
B ×25
v
C ×75
sp
sp
E ×12
D ×12
F ×40
G ×85
mr
H ×25
O ×250
I ×12
K ×85
J ×85
a
a
s
L ×85
gl
ts
mp
M ×85
lb
o
tb
ogl
ogl
ts
mr
N ×250
tb
o
tb
T ×17
P ×85
Q ×250
R
S ×40
U ×25
ar
o
o
ar
V ×1
W ×1

FIG. 140.—Anatomy of the Reteporidae Smitt, 1867.

FIG. 140.—Anatomy of the Reteporidae Smitt, 1867.

*gl*, oral glands; *mp*, parietal muscles; *mr*, retractor muscles of the polypide; *s*, septula; *sp*, spiramen; *ts*, tentacular sheath; *v*, vibracula.

A–C. *Schizellozoon sotanderia* Risso, 1826. A, B. Anterior and posterior sides, × 25. (After Waters, 1892.) C. Detail of the peristomie showing the spiramen, the spines, and the slit of the ovicell, × 75. (After Calvet, 1902.)

D–G. *Retepora cellutosa* Smitt, 1867. D. The proximal part of an old colony cut across transversally. The superficial kenozooecial layer is seen, × 12. E. The same piece as shown in fig. D, but the transversally cut surface is seen. The three groups of small round apertures, almost in the center of the section; are intersected zooecial chambers, which on both sides are covered by kenozooecia, × 12. F. A part of the transverse section in Fig. E, more highly magnified. The separating walls furnished with uniporous septulae are seen between the kenozooecia placed above each other, × 40. (D–F after Levinsen, 1909.) G. Section showing vicarious avicularia with gland-like bodies. Each avicularium is connected through septulae with two zooecia, × 85. (After Waters, 1892.)

H, I. *Schizellozoon imperati* Busk, 1884. Rooting process, × 25, and section of the same, × 12. (After Waters, 1888.)

J–L. *Retepora antarctica* Waters, 1904. J. Calcareous section showing the internal (*aa*) condyles (teeth) near the base of the operculum; also the lateral septula with "watch-glass" cover, × 85. K. Avicularian chamber with branches leading to the proximal end of the zooecium, × 85. L. Zooecium showing the oral (vaginal) glands (*gl*), and also the parietal muscles (*mp*), × 85.

M–O. *Hippellozoon hippocrepis* Waters, 1904. M. Section of zooecium showing the operculum (o), below which is the fleshy mass, with a tubular process from each side. To this fleshy mass the gigantic oral glands (*ogl*) are also attached, × 85. N. Section showing the tubular process (*tb*) below the operculum (*o*), × 250. O. Section of joint of oral spine, × 250. (J–O after Waters, 1904.)

Figs. P, Q. *Retepora cellulosa* Smitt, 1867. P. Section showing the gland-like sacks at the side, × 85. Q. Double sack, × 250. (P, Q after Waters, 1888.)

R. *Tryphyllozoon monilifera umbonata* MacGillivary, 1885. Operculum wtih its muscular attachments. (After MacGillivray, 1885.)

S. T. *Retepora beaniana* King, 1846 . S. A developing colony consisting of one ancestrula, two fully developed zooecia, and two developing zooecia, × 40. T. A somewhat older colony in which a root expansion of kenozooecia is already formed, × 17. (See figs. H, I.) (S, T after Levinsen, 1909.)

U. Calcareous section of *Retepora* showing the zooecial and dorsal layer with the lines of the vibices also visible. *a*, suboral pore entering the zooecial chamber considerably lower down than the aperture: *av*, avicularian chamber; *or*, ovicell; *v*, vibracula. This is a typical *Retepora*, but is practically drawn from *Retepora crassa* Busk, × 85. (After Waters, 1904.)

V, W. Two zoaria of *Retepora* natural size. (After Nordgaard.)

*Genotype.—Hippadenella* (*Flustra*) *margaritifera* Quoy and Gaymard, 1833. Recent.

It seems to us that it would be better to classify this genus in the Hippoporae, although all other authors are agreed in considering the genotype as belonging to the genus *Porella;* we can not maintain it there, the frontal being a pleurocyst and the apertura bearing cardelles.

## Family RETEPORIDAE Smitt, 1867.

*Anatomical bibliography.*—1878. Hincks, Notes on the Genus Retepora, Annals and Magazine Natural History, ser. 5, vol. 1, pl. 19.—1889. Waters, Supplementary Report on the Polyzoa collected by H. M. S. *Challenger*, pl. 3, figs. 5 to 13, 39, 40.—1892. Waters, Observations on the Gland-like Bodies in the Bryozoa, Linnean Society Journal, Zoology, vol. 24, pl. 19, fig. 14.—1894. Waters, On Mediterranean and New Zealand Reteporidae and a fenestrate Bryozoan, Linnean Society Journal, Zoology, vol. 25, pl. 7.—1903. Jullien, Bryozoaires provenant des Campagnes de *l'Hirondelle*, pp. 36, 62.—1904. Waters, Expedition antarctique belge, p. 77, pl. 6.—1909. Levinsen, Morphological and systematic studies on the Cheilostomatous Bryozoa, p. 290, pl. 10, pl. 23, figs. 1, 2, 3.—1909. Waters, Reports on the Marine Biology of the Sudanese Red Sea. The Bryozoa, Linnean Society Journal, Zoology, vol. 31, p. 175, pl. 18.—1913. Waters, Bryozoa from Zanzibar, Proceedings Zoological Society, London, pl. 72, figs. 1 to 11, p. 52 (classification).

The ovicell is hyperstomial, much immersed in the distal zooecium; it is largely open into the peristomie. The zoarium is generally reticulate; the dorsal face presents some projections or vibices without connection with the zooecia and contains interiorly some kenozooecia (lacunae of Waters) more or less numerous and elongated. The reteporidan pore placed in front of the apertura is according to its situation an ascopore or a spiramen; 11 to 16 tentacles.

Figure 140 sums up our anatomical knowledge of this family. We are ignorant of the larva and the generic classification is necessarily impossible to be stated with exactitude.

The classification has been given in 1892 and 1914 by Waters. We have given names to the principal groups which he formed. Levinsen introduced into this family the genera *Schizotheca* Hincks, 1880, and *Rhynchozoon* Hincks, 1891. It is evident that the four genera formed by Waters are in rapport with the hydrostatic system. It is now necessary for the zoologist to study the function of calcification with all the care possible.

### Genus RETEPORA Imperato, 1599.

1599. *Retepora* Imperato, Dell' historia naturale, libre XXVIII.

"This group has a fissure in the ovicell. The proximal edge of the operculum is nearly straight, and very similar throughout this group; labial avicularia occur in some but not in all. The oral glands are very well developed." (Waters.) The reteporidan pore is a spiramen.

*Genotype.—Retepora cellulosa* Linnaeus-Smitt, 1867.

*Range.*—Jacksonian-Recent.

*Historical.*—It is in this group as defined by Waters that the two genera *Retepora* and *Sertella* created by Jullien in 1903 may be classified. Following are their descriptions:

"*Retepora* Smitt 1867. Orifice transversely oval, deprived of denticules, an internal border to the ovicell and a spiramen on the frontal. Genotype: *Retepora cellulosa* Linnaeus-Smitt, 1867."

If the form of the operculum corresponded to this form of the apertura, the genus *Retepora* might be admitted into these limits, but the operculum of the genotype published by Waters in 1900 (see fig. 141) is identical with the other opercula of the same group and not at all elliptical.

"*Sertella* Jullien, 1903. Orifice elliptical with large transversal diameter, of which the anterior lip or anter is festooned and the posterior or poster is smooth and curvilinear; these two lips are separated from each side of the orifice by a very delicate and fragile cardelle. The frontal is here smooth and with some origells (=areolar pores). Genotype: *Retepora Beaniana* King, 1846."

We are ignorant regarding to what functions the festoons of the anter correspond exactly and it does not seem possible to us to accept a genus based on a character so insignificant. On the other hand, the presence of areolae indicates a special mode of calcification, a perfectly distinct function. Jullien's genus may therefore be maintained, but with this essential character. The study of the frontal of the Retepores has not yet been made with much care, and it is prudent to await it.

We are not certain that the reteporidan pore may really always be a spiramen, for Waters indicated an ascopore for *Retepora crassa* Busk, 1884. Our American species belong to this group, as defined by Waters.

### RETEPORA RAMOSA, new species.

Plate 65, figs. 15–25.

*Description.*—The zoarium is free, somewhat compressed, *branched*, dichotomous; it contains only three or four longitudinal rows of zooecia. The dorsal is smooth or very finely granular; the vibices are transverse, irregular, very little salient; some pores are disseminated between them. The zooecia are indistinct; the frontal is smooth and convex. The apertura is deeply imbedded, hardly visible; its anter is finely denticulated; the peristomice is ogival with a concave lower lip; the spiramen is an elongated slit, often united to the peristomice. The ovicell is hyperstomial, very deeply imbedded in the distal zooecia, hardly salient, smooth; it is perforated by an upper slit.

*Measurements.*—Peristomice $\begin{cases} hpe=0.12 \text{ mm.} \\ lpe=0.15 \text{ mm.} \end{cases}$

*Variations.*—On each side of the apertura there are usually some very salient tuberosities (fig. 18). The vibices are often replaced by furrows (fig. 20) on the same zoarium; then the small dorsal pores disappear. The ovicell is very fragile; the rupture of its frontal brings about the formation of a false slit (figs. 19, 21); its orifice is absolutely buried; it is never closed by the operculum (fig. 24).

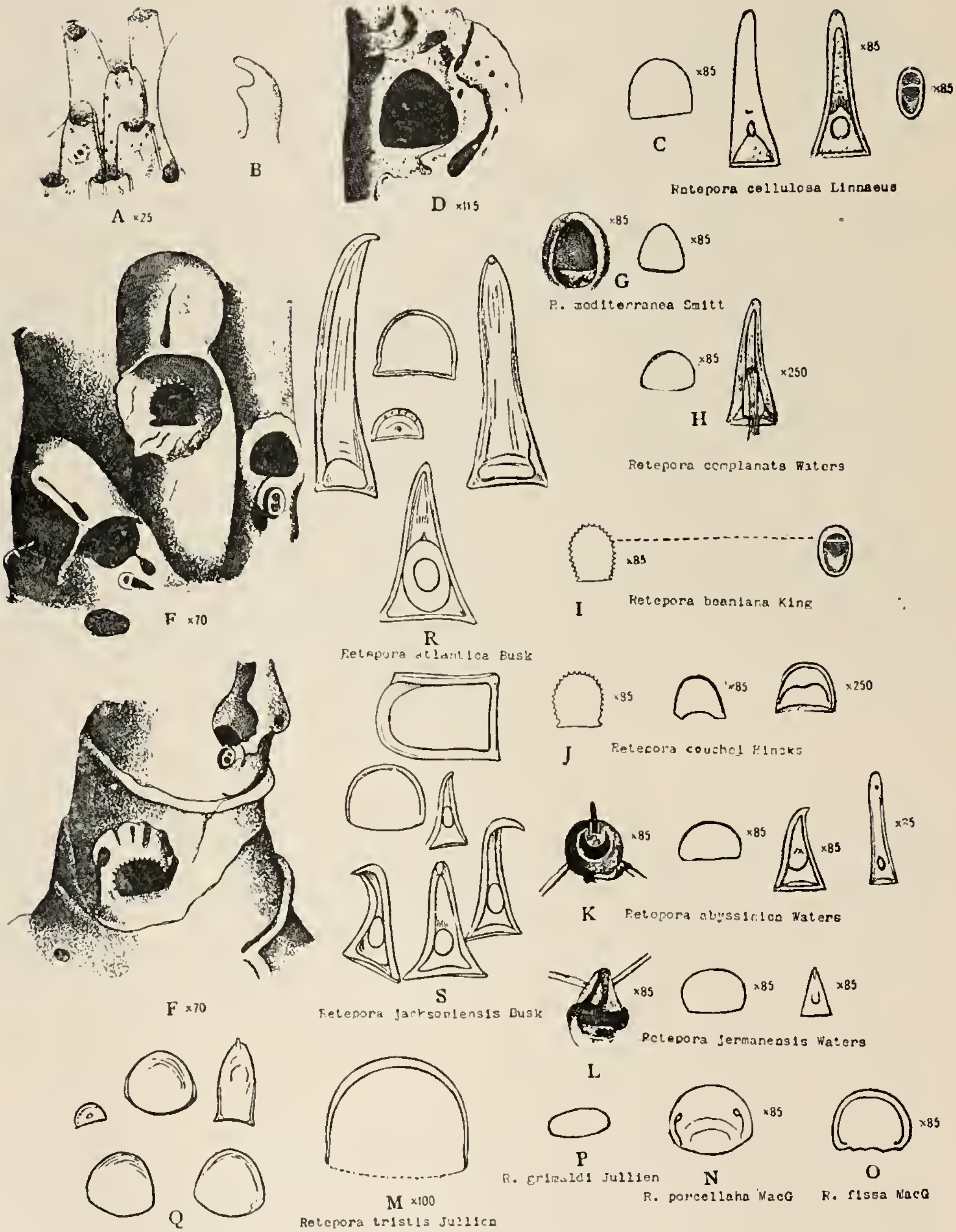

A ×25
B
D ×115
C
×85
×85
×85
Retepora cellulosa Linnaeus
G
×85
×85
R. mediterranea Smitt
H
×85
×250
Retepora complanata Waters
F ×70
R
Retepora atlantica Busk
I
×85
Retepora beaniana King
J
×85
×85
×250
Retepora couchi Hincks
K
×85
×85
×85
×85
Retepora abyssinica Waters
F ×70
S
Retepora jacksoniensis Busk
L
×85
×85
×85
Retepora jermanensis Waters
Q
M ×100
Retepora tristis Jullien
P
R. grimaldi Jullien
N
×85
R. porcellana MacG
O
×85
R. fissa MacG

Fig. 141.—Genus *Retepora* Imperato, 1599.

FIG. 141.—Genus *Retepora* Imperato, 1599.

A, B, C. *Retepora cellulosa* (Linnaeus) Smitt, 1867. A. Several zooecia, × 25. B. Avicularium. C. Operculum and mandible, × 85. (A–C after Waters, 1894, 1900.)

D. *Retepora* (*Sertella*) *gracilis* Jullien, 1903. Zooecium, × 115.

E. *Retepora* (*Sertella*) *aequitanica* Jullien, 1903. Several zooecia, × 70.

F. *Retepora* (*Sertella*) *oceanica* Jullien, 1903. Portion of a branch, × 70. (D–F after Jullien, 1903.)

G. *Retepora mediterranea* Smitt, 1867. Oral aperture and operculum, × 85. (After Waters, 1894.)

H. *Retepora complanata* Waters, 1894. Operculum, × 85, and mandible, × 250. (After Waters, 1894.)

I. *Retepora* (*Sertella*) *beaniana* King, 1846. Zooecial orifice and reteporidan avicularium, × 85. (After Jullien, 1903, and Waters, 1894.)

J. *Retepora couchii* Hincks, 1880. Zooecial orifice and opercula, × 85 and 250. (After Jullien, 1903, and Waters, 1878, 1885.)

K. *Retepora abyssinica* Waters, 1909. Zooecial orifice, operculum, and mandibles, × 85. (After Waters, 1909.)

L. *Retepora jermanensis* Waters, 1909. Zooecial orifice, operculum, and mandibles, × 85. (After Waters, 1909.)

M. *Retepora* (*Sertella*) *tristis* Jullien, 1909. Operculum, × 180. (After Jullien, 1903.)

N. *Retepora porcellana* MacGillivray, 1868. Operculum, × 85 (After MacGillivray, 1885.)

O. *Retepora fissa* MacGillivray, 1868. Operculum, × 85. (After MacGillivray, 1885.)

P. *Retepora grimaldi* Jullien, 1903. Zooecial orifice. (After Jullien, 1903.)

Q. *Retepora producta* Busk, 1884. Opercula and mandibles. (After Busk, 1884.)

R. *Retepora atlantica* Busk, 1884. Opercula and mandibles. (After Busk, 1884.)

S. *Retepora jacksoniensis* Busk, 1884. Opercula and mandibles. (After Busk, 1884.)

*Affinities.*—Busk, in 1884, created the genus *Reteporella* for the Retepores not reticulated; Jullien, in 1903, appears to have admitted this genus, but we can not recognize a genus based purely upon a zoarium, unless its zooecial characters are at the same time perfectly delimited.

This species differs from *Retepora simplex* (Busk) Reuss, 1869, in the absence of a labial mucro on the peristomice and of two oral avicularia.

*Occurrence.*—Middle Jacksonian: Wilmington, North Carolina (common); near Lenuds Ferry, South Carolina (common); Eutaw Springs, South Carolina (rare).

*Cotypes.*—Cat. Nos. 64158, 64159, U.S.N.M.

### RETEPORA SCUTULATA, new species.

Plate 65, figs. 9–14.

*Description.*—The zoarium is free, reticulate; with narrow and elongate *meshes* or fenestrae; the dorsal is smooth or very finely granulated; the vibices are rare and hardly salient. The zooecia are indistinct; the frontal is smooth and convex. The apertura is deep, buried, transverse; the peristomice is oblique, ogival; its anterior lip bears on one side a small avicularium, thin and elongated. The ovicell is little salient, smooth; it bears an upper, almost round cleft; its orifice is not visible.

*Measurements.*—Peristomice $\begin{cases} hpe=0.05 \text{ mm.} \\ lpe=0.10 \text{ mm.} \end{cases}$ Fenestrae $\begin{cases} Lf=0.75\text{–}1.35 \text{ mm.} \\ lf=0.45\text{–}0.50 \text{ mm.} \end{cases}$

*Affinities.*—This species differs from *Retepora ramosa* and *Retepora laciniosa* in its invariably reticulated zoarium.

It differs from *Retepora marginata* Reuss, in its indistinct and nonbordered zooecia, and from *Retepora vibicata* Goldfuss, 1827, in the absence of lateral areolar pores.

*Occurrence.*—Upper Jacksonian (Ocala limestone): Chipola River, east of Marianna, Jackson County, Florida (common); Alachua, Florida (rare).

*Cotypes.*—Cat. No. 64157, U.S.N.M.

### RETEPORA LACINIOSA, new species.

Plate 96, figs. 12–22.

*Description.*—The zoarium is free, branched, not reticulated, bifurcated, somewhat compressed, formed of three longitudinal rows of zooecia. The dorsal is smooth or granular; the vibices are very little salient, and circumscribe some irregular lozenge-shaped areas. The zooecia are indistinct; the frontal is smooth and convex. The apertura is semilunar (interior) and bears a minute proximal rimule irregularly placed; the peristomice is very oblique; it bears on its proximal lip a small tuberosity and a small oral avicularium separated by a *slit* or rimule-spiramen. The ovicell is hyperstomial but very deeply imbedded in the distal zooecia; its orifice is not visible; it bears superiorly a small slit, somewhat elongated. The small labial avicularium is frequently transformed into a large frontal avicularium.

*Measurements.—Peristomice.*—$lpe=0.11$ mm.

*Variations.*—The dorsal is sometimes smooth (fig. 16) and sometimes granular (figs. 15. 17); in the latter case the lozenge-shaped areas contain a round avicularium and an elliptical avicularium. In the young zooecia (fig. 14) when the small labial avicularium is not yet formed the rimule-spiramen is lateral and a median mucro separates it from another symmetrical slit. The aspect of the frontal changes completely when the labial avicularium is much developed (fig. 20); it is elongated, triangular with a somewhat rounded beak and it occupies then a part of the frontal.

*Affinities.*—This species differs from *Retepora ramosa* in which the zoarium is not reticulate, in the presence of a labial avicularium.

The rimule spiramen is the exact equivalent of the spiramen itself. A generic division may not be seriously established on their differentiation. They are moreover often observed together on the same zoarium.

*Occurrence.*—Vicksburgian (Marianna limestone): West bank Conecuh River, Escambia County, Alabama (common); Salt Mountain, 5 miles south of Jackson, Alabama (rare); 2½ miles north of Millry, Washington County, Alabama (rare); 1 mile north of Monroeville, Alabama (common).

Vicksburgian (Byram marl): One-fourth mile west of Woodward, Wayne County Mississippi (common).

*Cotypes.*—Cat. Nos. 64311–64313, U.S.N.M.

### Genus HIPPELLOZOON Canu and Bassler, 1917.

1917. *Hippellozoon* Canu and Bassler, Synopsis of American Early Tertiary Cheilostome Bryozoa, Bulletin 96, United States National Museum, p. 55.

The ovicell is widely open. There is neither labial avicularium nor reteporidan pore. The operculum is contracted in the middle, having long bands at the sides for the muscular attachments; the proximal edge is not straight. The aperture has two cardelles.

*Genotype.—Hippellozoon* (*Retepora*) *novaezelandiae* Waters, 1894. Recent.

Levinsen having introduced the genus *Rhynchozoon* Hincks, 1891, in the Reteporidae, we have decided to adopt the suffix "zoon" as characteristic of the family. It is evident that if the study of the larvae does not confirm the observation of Levinsen the names which we have given should not be preserved. There should be no law of priority in these attempts at synthetic nomenclature.

### Genus SCHIZELLOZOON Canu and Bassler, 1917.

1917. *Schizellozoon* Canu and Bassler, Synopsis American Early Tertiary Cheilostome Bryozoa, Bulletin 96, United States National Museum, p. 55.

The ovicell is widely open and provided with a semicircular slit. It has neither labial avicularium, nor reteporidan pore. The operculum has a broad thickened border; the proximal edge is not straight. The poster of the apertura bears a wide, little deep sinus.

*Genotype.—Schizellozoon* (*Retepora*) *imperati* Busk, 1884. Recent.

The spiramen (reteporidan pore of Waters) is replaced by a pseudo-spiramen, which is a groove in the proximal lip of the peristomice.

### Genus TRIPHYLLOZOON Canu and Bassler, 1917.

1917. *Triphyllozoon* Canu and Bassler, Synopsis American Early Tertiary Cheilostome Bryozoa, Bulletin 96, United States National Museum, p. 56.

"The ovicell has a 'trifoliate stigma.' There is generally a minute avicularium on the lip to one side. The opercula generally are fairly similar with a nearly straight proximal edge, and in shape rather wider than long, with the muscular attachments rather high up and near the border. Apparently all have the labial pore which is often the end of a long tube opening into the zooecium (=ascopore), proximally to the operculum." (Waters.)

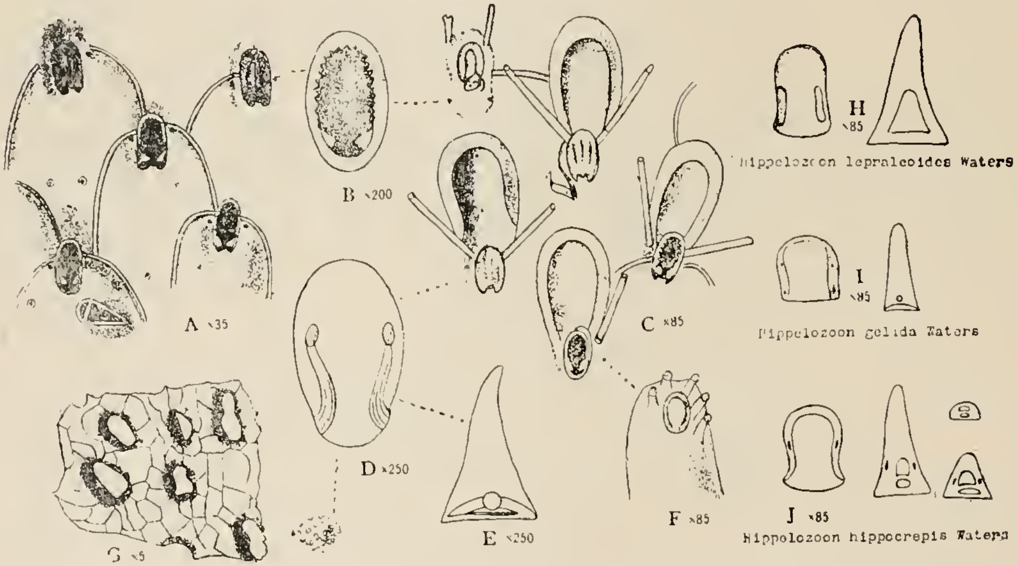

H ×85
Hippelozoon lepralioides Waters
B ×200
A ×35
I ×85
Hippelozoon gelida Waters
C ×85
D ×250
E ×250
F ×85
G ×5
J ×85
Hippelozoon hippocrepis Waters

Fig. 142.—Genus *Hippellozoon* Canu and Bassler, 1917.

A–G. *Hippellozoon novaezelandiae* Waters, 1894. A. Zooecia without ovicells, × 35. B. Aperture after the operculum has been removed, × 200. C. Zooecia with ovicell, × 85. D. Operculum, × 250. E. Avicularian mandible, × 250. F. Young zooecium, × 85. G. Dorsal surface, × 5. (A–G after Waters, 1894.)

H–J. Opercula and mandibles. H. *Hippellozoon lepralioides* Waters, 1894. I *H. gelida* Waters, 1904. J. *H. hippocrepis* Waters, 1904. (H–J after Waters.)

*Genotype.—Triphyllozoon* (*Retepora*) *moniliferum* MacGillivray, 1860. Recent.

### Genus RHYNCHOZOON Hincks, 1891.

1881. *Rhynchopora* Hincks, British Marine Polyzoa, p. 385. (Preoccupied; replaced by *Rhynchozoon* in 1891.

"This genus seems to be characterized by the possession of a more or less well-developed sinus on the apertura, by its ovicell, which has an entire frontal surface

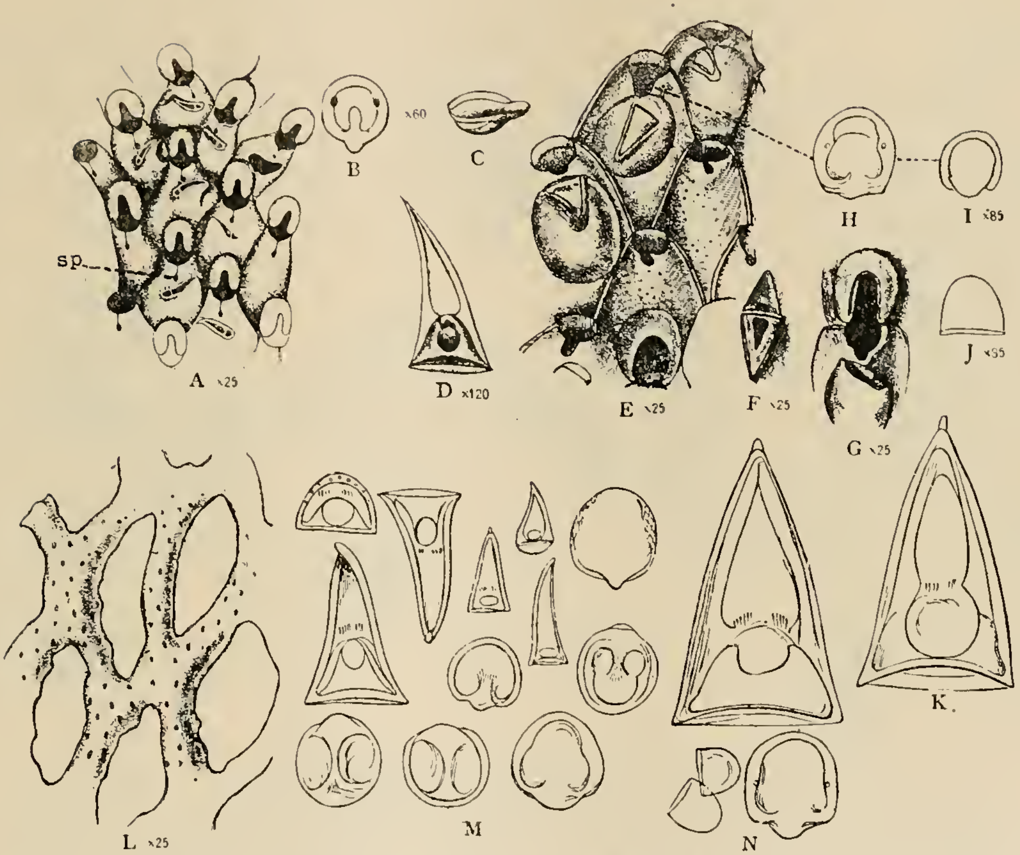


Fig. 143.—Genus *Schizellozoon* Canu and Bassler, 1917.

A–D. *Schizellozoon solanderia* Risso, 1826. A. Portion of a colony at the point of bifurcation showing the frontal structure of the adult zooecia and of the ovicells, × 25 (*sp*=pseudo spiramen). B, C. Operculum, × 60; seen normally and in profile. D. Mandible of a frontal avicularium, × 120. (A–D after Calvet, 1902.)

E–L. *Schizellozoon imperati* Busk, 1884. E. Zooecia provided with a pseudo-spiramen, × 25. F. Frontal avicularium, × 25. G. Ovicell, × 25. H, I. Operculum, × 85. (After Waters, 1858.) J. Mandible of a small frontal avicularium, × 85. K. Mandible of a large frontal avicularium. L. Posterior side of a zoarium, × 25. (E–H, J–L after Busk, 1884.)

M. *Schizellozoon tessellatum* Hincks, 1878. Group of opercula and mandibles. (After Busk, 1884.)

N. *Schizellozoon elongatum* Busk, 1884. Opercula and mandible. (After Busk, 1884.)

and is provided with an incomplete ooecial cover and by the possession of pore-chambers (dietellae)." (Levinsen.)

*Genotype.—Rhynchozoon* (*Lepralia*) *bispinosa* Johnston, 1849. Recent.

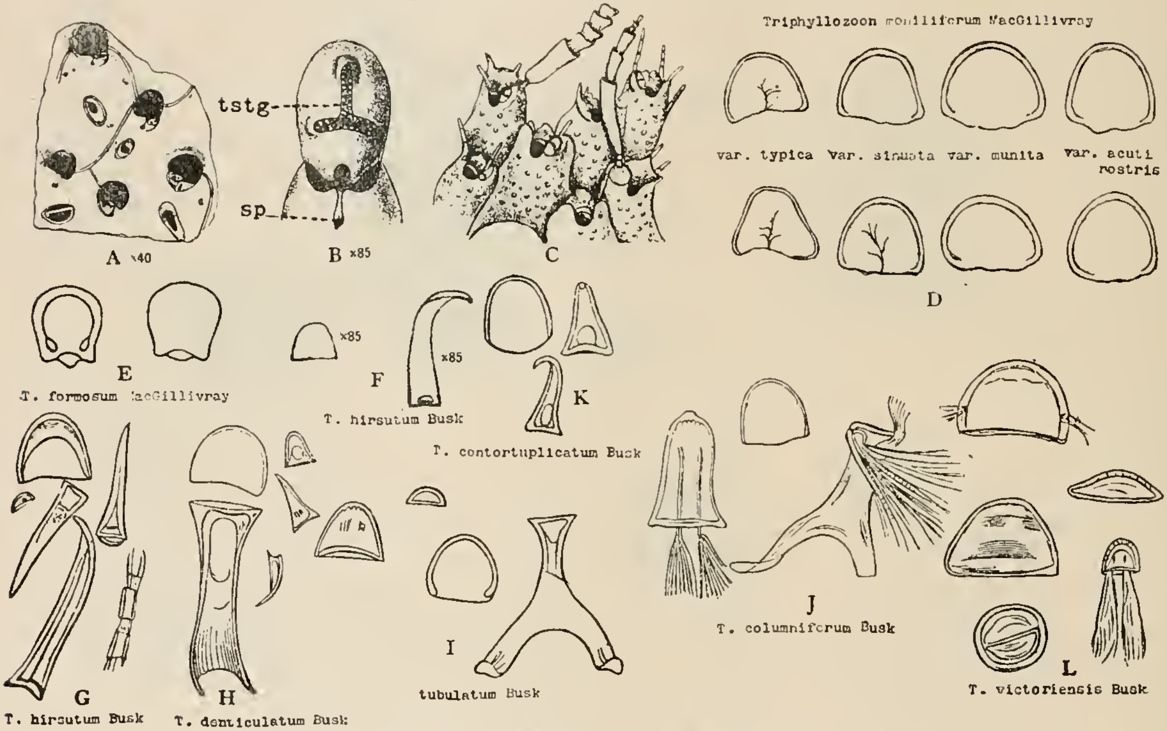

Triphyllozoon moniliferum MacGillivray
tstg
sp
A ×40
B ×85
C
var. typica
var. sinuata
var. munita
var. acuti rostris
D
E
T. formosum MacGillivray
×85
×85
F
T. hirsutum Busk
K
T. contortuplicatum Busk
G
T. hirsutum Busk
H
T. denticulatum Busk
I
tubulatum Busk
J
T. columniferum Busk
L
T. victoriensis Busk

FIG. 144.—Genus *Triphyllozoon* Canu and Bassler, 1917.

A–D. *Triphyllozoon moniliferum* MacGillivray, 1860. A. Zooecia of var. *munita* Hincks, 1880; × 40. B. Ovicelled zooecium of var. *munita* Hincks, 1880, × 85, showing the trifoliate stigma (*tstg*) of the ovicell and the spiramen (*sp*) of the peristomie. (A, B after Waters, 1894.) C. Zooecia showing articulated spines. D. Operculum of the principal varieties. (C, D after MacGillivray, 1885.)

E–L. Opercula and mandibles. E. *Triphyllozoon formosum* MacGillivray. (After MacGillivray, 1885.) F. *T. hirsutum* Busk, 1884. (After Waters, 1909.) G. *T. hirsutum* Busk, 1884. H. *T. denticulatum* Busk, 1884. I. *T. tubulatum* Busk, 1884. J. *T. columniferum* Busk, 1884. K. *T. contortoplicatum* Busk, 1884. L. *T. victoriensis* Busk. 1884. (G–L after Busk, 1884.)

## Genus SCHIZOTHECA Hincks, 1877.

1877. *Schizotheca* HINCKS, On British Polyzoa, Pt. II, Classification, Annals Magazine Natural History, ser. 4, vol. 20, p. 528; 1880, British Marine Polyzoa, p. 283.

"Zoœcia with a suborbicular primary orifice, the lower margin sinuated; the secondary orifice raised, tubular, notched in front. Ovicell terminal, with a fissure in the front wall, never closed by the operculum."

*Genotype.—Schizotheca* (*Lepralia*) *fissa* Busk, 1858. Recent.

Levinsen classified this genus in the Reteporidae, where we also believe it better placed.

### Genus LEPRALIELLA Levinsen, 1916.

1916. *Lepraliella* LEVINSEN, Bryozoa Denmark-Ekspeditionen til Gronlands Nordostkyst 1906–1908, vol. 3, No. 16. p. 466.

"The zooecia are provided with a distinct, not beaded or faintly so, vestibular arch, and with two well-developed hinge-teeth. A well chitinized operculum. Avicularia of different size and position. The ovicells, the proximal portion of which is not pedicel-shaped or shaft-like, have no pores and are not provided with an inwards directed tongue." (Levinsen.)

*Genotype.—Lepraliella* (*Cellepora*) *contigua* Smitt, 1867. Recent.

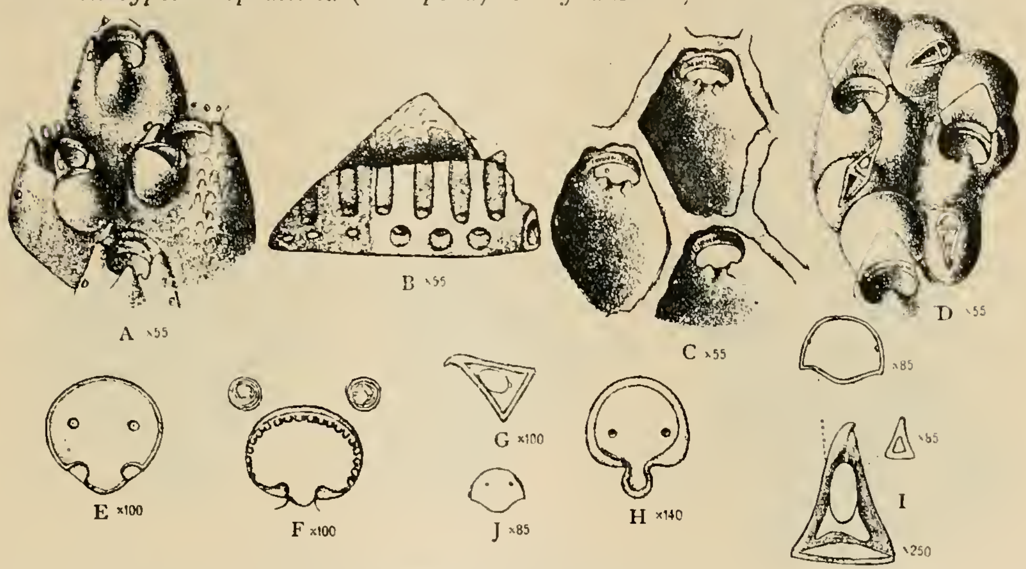


FIG. 145.—Genus *Rhynchozoon* Hincks, 1891.

A–G. *Rhynchozoon angulatum* Levinsen, 1909. A. Zooecia, × 55. B. A zooecium, seen from the left side wall. On the left side is seen an avicularium, × 55. C. Zooecia seen from the basal side after removal of the basal wall. × 55. D. Ovicelled zooecia, × 55. E. Operculum, × 100. F. The aperture with the operculum in situ. The beaded vestibular arch is seen shining through the operculum, × 100. G. Avicularian mandible, × 100. (A–G after Levinsen, 1909.)

H–J. Opercula and mandibles. H. *Rhynchozoon scintillans* Hincks, 1885, × 140. (After Levinsen, 1909.) I. *R. profundum* MacGillivray, 1881. (After Waters, 1887.) J. *R. corrugatum* Thornely, 1905, × 85. (After Waters, 1909.)

## Family GALEOPSIDAE Jullien, 1903.

1903. JULLIEN, Bryozoa provenant des Campagnes de *l'Hirondelle*, pl. 14.

The ovicell is hyperstomial and opens into the peristomie above the operculum. A spiramen introduces into the peristomie the water destined afterwards for the compensatrix.

In the family of the Adeonidae, as in that of the Reteporidae, this spiramen also exists; it is in evident relation with the hydrostatic system, as is proved by the examination of the young zooecia. In most of the species of Galeopsidae the spiramen, if it be in rapport with the hydrostatic system, might have another use, another function, unfortunately still unknown. It is not possible, for example, to compare the size of the spiramen of *Galeopsis* with the smallness of the orifice of the compensatrix simply closed by a rimule or by a poster of an operculum. On the other hand, it is quite frequent to find on the same zoarium some zooecia deprived of spiramen and which nevertheless are still living and contain a polypide.

In the family of the Tessaradomidae Jullien, 1903, the spiramen opens into the peristomie just at the level of the operculum; exteriorly it is placed much lower, always eccentrically and may be confused with the ascopore of the Acroporidae.

We have no knowledge of the larva of the Galeopsidae and Tessaradomidae, and we think that it is preferable to unite them provisionally in a single family; the distance of the spiramen from the operculum does not seem to us a character sufficient to influence the larval system.

In the species with thick frontal the tubules cover the ovicell, which becomes invisible exteriorly; the sections permit of their discovery in the vicinity of the zoarial axis.

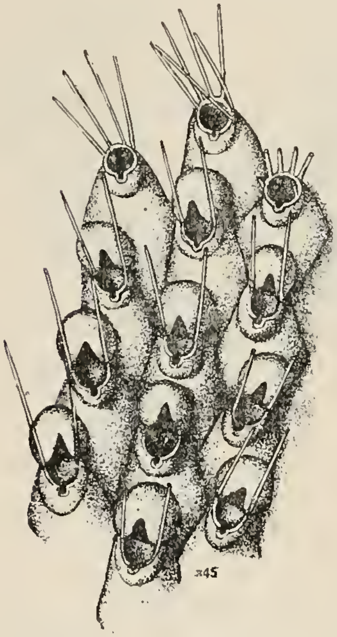


FIG. 146.—Genus *Schizotheca* Hincks, 1877.

*Schizotheca fissa* Busk, 1858. Zooecia, × 45, with and without ovicell. (After Hincks, 1880.)

### Genus GALEOPSIS Jullien, 1903.

1903. *Galeopsis* JULLIEN, Bryozoa provenant des Campagnes de *l'Hirondelle*, p. 94

The spiramen is very large and salient. The apertura has two cardelles. The frontal is a tremocyst or an olocyst.

*Genotype.*—*Galeopsis rabidus* Jullien, 1903.

*Range.*—Maestrichtian—Recent.

The nature of the frontal is not always evident in this genus. As we have not been successful with our tangential sections, we have accepted the genus as it was defined by its author.

The known fossil species of this genus are:

*Galeopsis*, new species. Cretaceous (Vincentown), New Jersey and Delaware.
*Galeopsis* (*Eschara*) *heterostoma* Reuss, 1869. Priabonian.
*Galeopsis* (*Eschara*) *duplicata* Reuss, 1869. Priabonian.
*Galeopsis* (*Porina*) *cribraria* MacGillivray, 1895. Miocene of Australia.
*Galeopsis* (*Porina*) *tuberculosa* Maplestone, 1902. Miocene of Australia.
*Galeopsis* (*Porina*) *columnata* Waters, 1881. Miocene of New Zealand.
*Galeopsis*, new species, Plaisancian of England (Collection, Canu).

The recent species are:
*Galeopsis rabidus* Jullien, 1903. Atlantic (Azore Islands).
*Galeopsis pupa* Jullien. 1903. Pacific (Gambier Islands).
*Galeopsis* (*Hippothoa*) *fenestrata* Smitt. 1872. Atlantic (Florida).

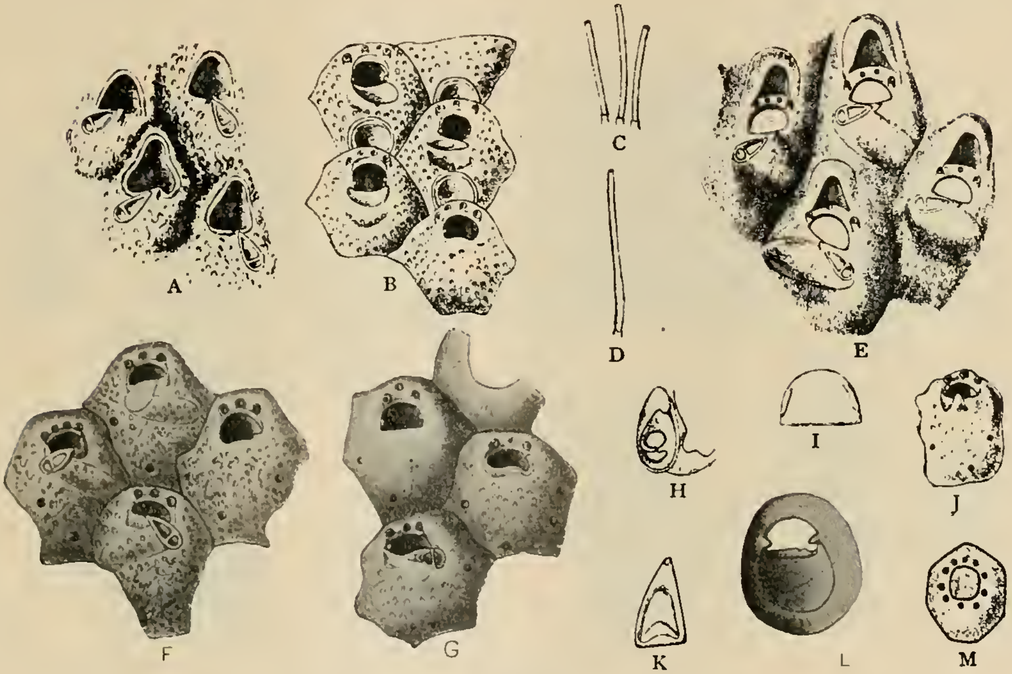


FIG. 147.—Genus *Lepraliella* Levinsen, 1916.

A–M. *Lepraliella contigua* Smitt, 1867. A. Zooecia with avicularia. B. Zooecia with oral spines. C, D. Spines. E. Ooeciferous zooecia. F. Zooecia provided with pores. G. Zooecia with apertures of different forms. H. Avicularium. I. Operculum showing the marginal ridges. J. Zooecium with a mucronate peristome. K. Triangular mandible. L. Aperture with oral teeth. M. Ancestrula. (After Levinsen, 1916.)

### GALEOPSIS (?) CONVEXA, new species.

Plate 8, figs. 1, 2.

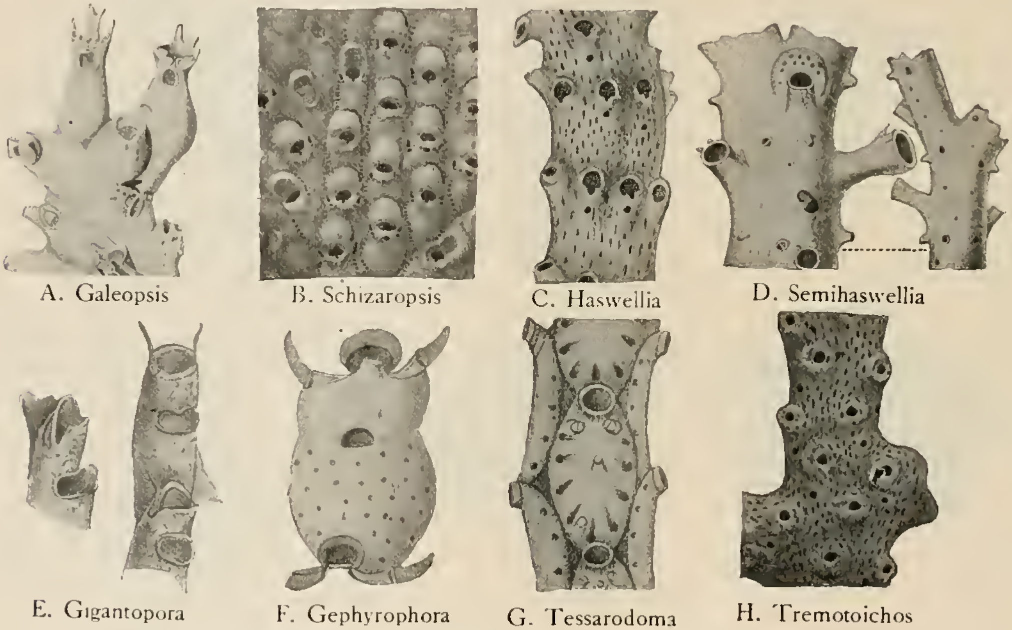
*Description.*—The zoarium is an Eschara with claviform fronds; the two lamellae are inseparable. The zooecia are distinct, elongated, elliptical; the frontal is smooth, quite *convex*. The peristomice is orbicular; the peristome is thin, sharp, and bears laterally a very large triangular avicularium with pivot. The ovicell is large, salient, imbedded in the distal zooecium, and opens into the peristomie. On the frontal there is a large semicircular ascopore surmounted by two small pores.

*Measurements.*—Peristomice $\begin{cases} hpe=0.14 \text{ mm.} \\ lpe=0.14 \text{ mm.} \end{cases}$ Zooecia $\begin{cases} Lz=0.60\text{–}0.80 \text{ mm.} \\ lz=0.40 \text{ mm.} \end{cases}$

*Affinities.*—The few specimens found have not permitted a detailed study of this species. We are ignorant of the exact nature of the frontal pore. It is by analogy simply that we have classified the species in *Galeopsis.*

*Occurrence.*—Midwayan (Clayton limestone): One mile west of Fort Gaines, Georgia (rare).

*Cotypes.*—Cat. No. 63826, U.S.N.M.


A. Galeopsis B. Schizaropsis C. Haswellia D. Semihaswellia

E. Gigantopora F. Gephyrophora G. Tessarodoma H. Tremotoichos

FIG. 148.—Genera of the family Galeopsidae Jullien, 1903.

A. *Galeopsis rabidus* Jullien, 1903, × 25. Recent.
B. *Schizaropsis convexa* Canu and Bassler, 1917, × 20. Jacksonian of Mississippi.
C. *Haswellia australiensis* Busk, 1884, × 25. Recent.
D. *Semihaswellia proboscidea* Waters. 1889, × 12. Recent.
E. *Gigantopora lyncoides* Ridley, 1881. Recent.
F. *Gephyrophora polymorpha* Busk, 1884, × 25. Recent.
G. *Tessarodoma gracile* Sars, 1850, × 60. Recent.
H. *Tremotoichos rectifurcatum* Canu and Bassler, 1917, × 20, Jacksonian of North Carolina.

### GALEOPSIS LONGICOLLIS, new species.

Plate 66, fig. 1.

*Description.*—The zoarium incrusts bryozoa. The zooecia are distinct, elongated, convex; the frontal bristles with hollow spines; the peristomie is very *long*, cylindrical, smooth. The spiramen is salient, transverse, elliptical, placed at the base of the peristomie; the peristomice is irregular, very oblique, suborbicular; the peristome is thin and sometimes bears a quite small avicularium.

*Measurements.*—Zooecia $\left\{\begin{array}{l} Lz=0.75\text{–}1.00 \text{ mm.} \\ lz=0.35\text{–}0.40 \text{ mm.}\end{array}\right.$

This species differs from *Galeopsis verrucosa* in its much smaller spiramen and in its narrower zooecia.

It differs from *Galeopsis erinaceus* in its spiramen much smaller than the peristomice and in the greater length of the peristomie (=0.45 mm.).

*Occurrence.*—Middle Jacksonian (Castle Hayne limestone): Wilmington, North Carolina (very rare).

*Holotype.*—Cat. No. 64160, U.S.N.M.

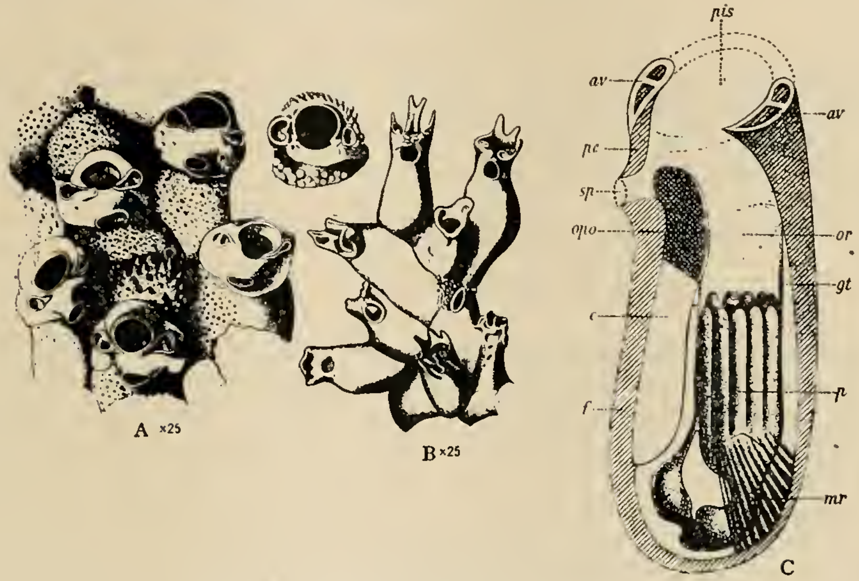


FIG. 149.—Genus *Galeopsis* Jullien, 1903.

A. *Galeopsis pupa* Jullien, 1903. Zooecia, × 25.

B. *Galeopsis rabidus* Jullien, 1903. Zooecia, × 25.

C. Schematic view showing the general organization of a zooecium. (A–C after Jullien.)

*av*, avicularium; *c*, compensatrix; *f*, frontal wall; *gt*, tentacular sheath; *mr*, retractor muscles of polypide; *opo*, operculum; *or*, true orifice or apertura; *p*, polypide; *pe*, peristome; *pis*, peristomice; *sp*. spiramen.

### GALEOPSIS VERRUCOSA, new species.

Plate 66, fig. 3.

*Description.*—The zoarium is unilamellar, incrusting algae or shells. The zooecia are elongated, distinct, elliptical, or oval; the frontal is very convex and ornamented with numerous salient and pointed *wartlike* nodes. The apertura, hidden at the base of the peristomie, is formed of a large anter and of a somewhat smaller poster separated by two cardelles; the peristomice is orbicular; the peristomie is recumbent on the distal zooecia; the peristome is thin, sharp, and often bears a small, triangular avicularium with pivot. The ovicell is hyperstomial; it opens largely into the peristomie. The spiramen is immense, salient, elliptical and transverse.

*Measurements.*—Apertura $\left\{\begin{array}{l} ha=0.14\text{–}0.16 \text{ mm.} \\ la=0.14\text{–}0.18 \text{ mm.} \end{array}\right.$ Zooecia $\left\{\begin{array}{l} Lz=0.80 \text{ mm.} \\ lz=0.50 \text{ mm.} \end{array}\right.$

*Affinities.*—This species much resembles *Galeopsis crinaeeus.* It differs from it in its greater zooecial length (greater than 0.60 mm.) and in its spiramen which has not the form of a transversal slit.

*Occurrence.*—Middle Jacksonian (Castle Hayne limestone): Wilmington, North Carolina (rare).

*Holotype.*—Cat. No. 64162, U.S.N.M.

### GALEOPSIS ERINACEUS, new species.

Plate 66, fig. 2.

*Description.*—The zoarium incrusts shells. The zooecia are elongated, distinct, elliptical, little regular; the frontal is convex and *bristles* with small points. The apertura hidden at the bottom of the peristomie has two cardelles placed a little low; the peristomice is orbicular; the peristome is thin, salient, irregular, notched; the peristomie is recumbent on the distal zooecia. The spiramen is very large, transverse, elliptical, salient, much wider than the peristomice.

*Measurements.*—Apertura $\left\{\begin{array}{l} ha=0.08\text{–}0.10\text{ mm.}\\ la=0.10\text{ mm.}\end{array}\right.$ Zooecia $\left\{\begin{array}{l} Lz=0.60\text{ mm.}\\ lz=0.36\text{ mm.}\end{array}\right.$

*Affinities.*—This species is quite well characterized by its spiramen in the form of an elongated and narrow slit. It differs in addition from *Galeopsis verrueosa* in its smaller micrometric dimensions.

*Occurrence.*—Middle Jacksonian (Castle Hayne limestone): Wilmington, North Carolina (rare).

*Holotype.*—Cat. No. 64161, U.S.N.M.

### GALEOPSIS CYCLOPS, new species.

Plate 66, figs. 4, 5.

*Description.*—The zoarium incrusts shells. The zooecia are elongated, distinct, fusiform, or cylindrical; the frontal is a little convex and formed of a tremocyst with much scattered pores. The peristome is salient, thin; it bears distally a small *round avicularium* without pivot; the peristomice is orbicular; the peristomie is quite oblique and is recumbent on the distal zooecium. The spiramen is large, orbicular, not salient, smaller then the peristomice.

*Measurements.*—Peristomice $\left\{\begin{array}{l} hpe=0.10\text{ mm.}\\ lpe=0.10\text{ mm.}\end{array}\right.$ Zooecia $\left\{\begin{array}{l} Lz=0.45\text{–}0.50\text{ mm.}\\ lz=0.25\text{ mm.}\end{array}\right.$

*Variations.*—The young zooecia have no spiramen; it is replaced by a deep sinus of the peristome as in the Stomachetosellidae (fig 4). The ancestrula (fig. 5) is an ordinary zooecium.

*Affinities.*—This species much resembles *Eschara heterostoma* Reuss, 1869, of the Priabonian from the Vicentin. It differs from it in its incrusting and not escharian zoarium and in the presence of the small distal avicularia.

It differs from *Galeopsis erinaceus* and *Galeopsis verrucosa* in its much smaller and not salient spiramen.

*Occurrence.*—Upper Jacksonian (Ocala limestone): Alachua, Florida (very rare).

*Holotype.*—Cat. No. 64163, U.S.N.M.

### Genus SCHIZAROPSIS Canu and Bassler, 1917.

1917. *Schizaropsis* CANU and BASSLER, Synopsis American Early Tertiary Cheilostome Bryozoa, Bulletin 96, United States National Museum, p. 57.

The apertura bears a straight proximal border notched by a small rectilinear rimule. The frontal is garnished laterally with areolae; it is formed of a very finely granulated pleurocyst placed on a thick olocyst. The spiramen is almost as large as the peristomice.

*Genotype.*—*Schizaropsis convexa* Canu and Bassler, 1917. Jacksonian.

### SCHIZAROPSIS CONVEXA Canu and Bassler, 1917.

Plate 66, figs. 6, 7.

1917. *Schizaropsis convexus* CANU and BASSLER, Synopsis American Early Tertiary Cheilostome Bryozoa, Bulletin 96, United States National Museum, p. 57, pl. 5, fig. 7.

*Description.*—The zoarium incrusts oysters; the zooecia are grouped in linear longitudinal lines. The zooecia are distinct, a little elongated, elliptical, or rectangular; the frontal is very *convex*, smooth, or very finely granular, bordered laterally with six large, widely spaced areolae. The apertura is formed of a semilunar anter and of a straight proximal border notched by a small rectilinear rimule. The spiramen is elliptical, transverse, placed on the exterior peristomie, almost as wide as the peristomice. The ovicell is globular, salient, smooth; it is hyperstomial and opens by a very large orifice above the apertura and opposite the spiramen. Two small triangular avicularia are placed symmetrically on each side of the apertura.

*Measurements.*—Apertura $\begin{cases} ha = 0.05 \text{ mm. (without rimule).} \\ la = 0.07 \text{ mm.} \end{cases}$

Zooecia $\begin{cases} Lz = 0.35\text{–}0.50 \text{ mm.} \\ lz = 0.30 \text{ mm.} \end{cases}$

*Variations.*—The young zooecia have no superior arch and are deprived of spiramen. On the adult zooecia when the superior arch is not formed the lateral lips of the peristomie limit a rimule-spiramen. The lateral areolae are little visible because of the very large convexity of the frontal; they are quite apparent when the preparation is properly inclined.

The spiramen is little visible by perspective because it is in a plane almost perpendicular to the zooecial plane.

*Occurrence.*—Lower Jacksonian (Moodys marl): Jackson, Mississippi (rare).

*Cotypes.*—Cat. No. 62603, U.S.N.M.

### Genus HASWELLIA Busk, 1884.

1884. *Haswellia* Busk, Report on the Polyzoa collected by H. M. S. *Challenger*, pt. 1, p. 171.

The apertura has its proximal border notched by a very wide rimule not separated from the anter. The frontal is a very thick tremocyst. The spiramen is a small salient tube. The zoarium is cylindrical.

*Genotype.*—*Haswellia* (*Myriozoum*) *australiensis* Haswell, 1880.

*Range.*—Jacksonian—Recent.

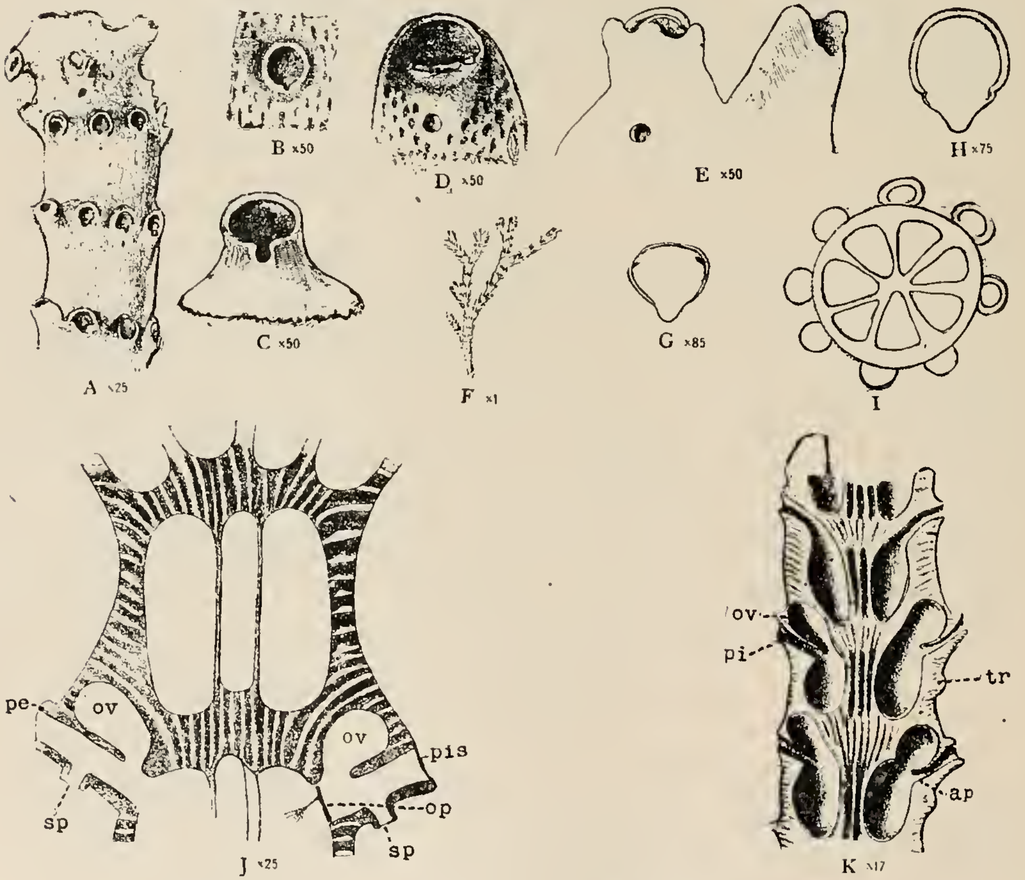


FIG. 150.—Genus *Haswellia* Busk, 1884.

A–K. *Haswellia australiensis* Haswell, 1889. A. Zooecia, × 25. B, C, D, E. Successive aspects of the visible orifice, × 50, showing development of the peristomie. F. Zoarium natural size. (A–F after Busk, 1884.) G. Operculum, × 85. (After Waters, 1881.) H. Operculum, × 75. (After Levinsen, 1909.) I. Transverse section. (After Busk, 1884.) J. Longitudinal section, × 25. (After Waters, 1909.) K. Longitudinal section, × 17. (After Levinsen, 1909.)

*ap*, apertura; *op*, operculum closing the apertura; *ov*, ovicell; *pe*, peristome; *pi*, peristomie; *pis*, peristomice; *sp*, spiramen; *tr*, frontal tremocyst.

### HASWELLIA GRACILIS, new species.

Plate 66, figs. 8–10.

*Description.*—The zoarium is free, cylindrical, *slender*. The zooecia are disposed all around the zoarium; they are quite long and indistinct; the frontal is a thick tremocyst with small, numerous pores. The peristome is salient, almost perpendicular to the zoarium; the peristomice is orbicular; the peristomie is invisible exteriorly, but it is as long as the zooecia. The spiramen is a small, salient, oblique tube placed on the median zooecial axis just below the peristome.

*Measurements.*—Apertura $\left\{\begin{array}{l} ha=0.09 \text{ mm.} \\ la=0.09 \text{ mm.} \end{array}\right.$ Zooecia.—$Lz=0.75–1.50$ mm.

*Affinities.*—In spite of its very simple structure this species has necessitated long study. Success with the longitudinal sections (fig. 9) has permitted us to classify it generically. The spiramen is higher than the peristomie and quite distant from the apertura.

This species much resembles the recent *Porina proboscidea* Waters, 1888. It differs from it in its much smaller micrometric dimensions and in its zooecia disposed all round the zoarium and not on one side alone. It sometimes has a small avicularium placed in the vicinity of the apertura.

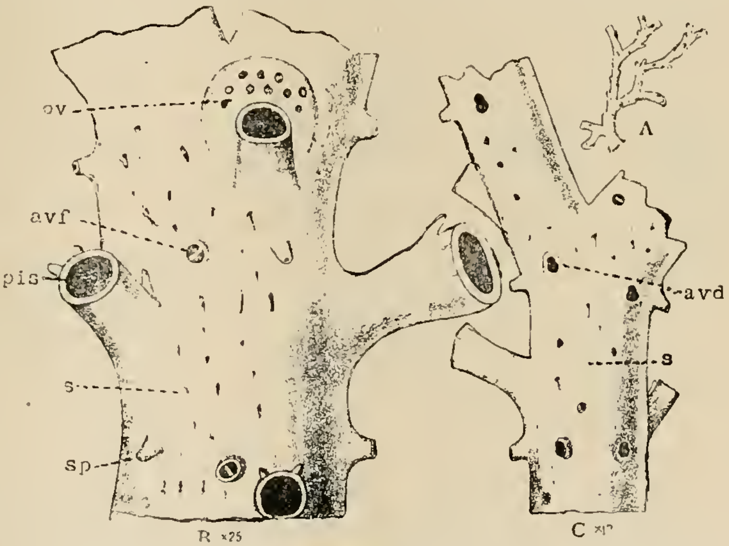


FIG. 151.—Genus *Semihaswellia* Canu and Bassler, 1917.

A–C. *Semihaswellia proboscidea* Waters, 1889. A. Zoarium natural size. B. Fragment of branch with ordinary and ovicelled zooecia, × 25. C. Posterior face without zooecia, × 12. (A–C after Waters, 1889.)

*avd*, dorsal avicularium; *avf*, frontal avicularium; *ov*, ovicell; *pis*, exterior orifice or peristomice, never closed by the operculum; *s*, sulci; *sp*, spiramen.

*Occurrence.*—Middle Jacksonian (Castle Hayne limestone): Wilmington, North Carolina (very common).

*Holotype.*—Cat. No. 64164, U.S.N.M.

### Genus SEMIHASWELLIA Canu and Bassler, 1917.

1917. *Semihaswellia* CANU and BASSLER, Synopsis of American Early Tertiary Cheilostome Bryozoa, Bulletin 96, United States National Museum, p. 58.

The zooecia are disposed only on one side of the zoarium; the dorsal bears only avicularia. The frontal and the dorsal are of the same nature and are formed of a tremocyst with sulci.

*Genotype.—Porina proboscidae* Waters, 1889.

*Range.*—Jacksonian—Recent.

This genus is zoarial; no special distinct zooecial function separates it from *Haswellia.* Nevertheless, it has some important zoarial functions susceptible of giving generic characters; the very constant presence of small dorsal avicularia seems to be a very good character. The recent specimens are extremely rare and it is still not possible to study them in detail.

### SEMIHASWELLIA TRIPORA, new species.

Plate 66, figs. 24–27.

*Description.*—The zoarium is free, somewhat compressed, not branched, bearing laterally large apophyses quite salient; there are three longitudinal rows of zooecia indicated on the dorsal by as many rows of small round avicularia. The zooecia are small. indistinct; the frontal is a tremocyst with sulci. The peristome is quite salient, perpendicular to the zooecial plane, thin and garnished with two small distal avicularia, almost symmetrical; the peristomice is orbicular. The spiramen is a small pore placed just below the peristome, not salient.

*Measurements.*—Peristomice $\left\{\begin{array}{l} hpe=0.05 \text{ mm.} \\ lpe=0.05 \text{ mm.} \end{array}\right.$ Zooecia.—$Lz=0.35\text{–}0.40$ mm.

*Affinities.*—This species differs from *Semihaswellia exilis* in its very salient peristome and in its much shorter zooecia, less than 0.50 mm.

*Occurrence.*—Middle Jacksonian: Near Lenuds Ferry, South Carolina (rare).

*Cotypes.*—Cat. No. 64167, U.S.N.M.

### SEMIHASWELLIA EXILIS, new species.

Plate 66, figs. 11–23.

*Description.*—The zoarium is free, cylindrical, *thin*, formed of three longitudinal rows of zooecia opening on only one side; it often bears laterally some cylindrical hollow appendages. The zooecia are indistinct; the frontal is confused with the zoarial surface; it is formed of a thick tremocyst with tubules, placed on a perforated olocyst; the dorsal is of the same construction and bears a small round salient avicularium without pivot. The peristome is salient, thin, almost perpendicular to the zooecial plane; the peristomice is orbicular. The spiramen is small, not salient, and placed on the median axis of the zooecium immediately below the peristome.

*Measurements.*—Peristomice $\left\{\begin{array}{l} hpe=0.05 \text{ mm.} \\ lpe=0.05\text{–}0.07 \text{ mm.} \end{array}\right.$ Zooecia.—$Lz=0.45\text{–}0.50$ mm.

*Variations.*—The peristome quite often bears two small avicularia symmetrically placed (fig. 15). The sulci (figs. 15, 16) do not always appear with clearness on our fossils (figs. 12, 14); these are the very fragile ornaments which fossilization much attenuates.

We have made numerous longitudinal sections without ever discovering the ovicell; the 50 specimens observed have shown none of them visible exteriorly as in the genotype. However we have not yet concluded that they are absent, as in such small zoaria they are fragile. One of the sections taken through the zoarial apophyses shows that these are hollow; we are absolutely ignorant of their use, for we have no analogous case in the recent species.

*Affinities.*—This species is easy to differentiate from *Semihaswellia tripora;* its small peristomial pores are much smaller and hardly visible; its zooecial length is larger (more than 0.40 mm.); the zoarial apophyses are smaller.

*Occurrence.*—Jacksonian (Zeuglodon zone): Cocoa post office, Choctaw County, Alabama (very rare).

Upper Jacksonian (Ocala limestone): Chipola River, east of Marianna, Florida (rare); Old Factory, about 1½ miles above Bainbridge, Georgia (rare).

Vicksburgian (Marianna limestone): West bank of Conecuh River, Escambia County, Alabama (very common); 2½ miles north of Millry, Washington County, Alabama.

*Cotypes.*—Cat. No. 64166, U.S.N.M.

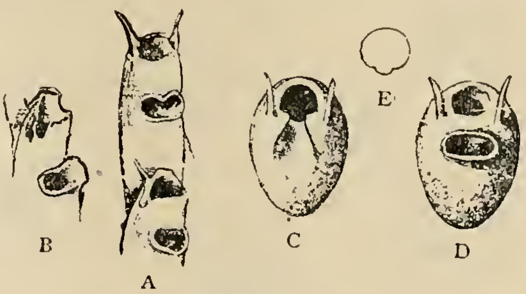


Fig. 152.—Genus *Gigantopora* Ridley, 1881.

A–E. *Gigantopora lyncoides* Ridley, 1881. A, B. Zooecia, seen from the front and in profile. (After Ridley, 1881.) C. Young zooecium. D. Normal zooecium. E. Operculum. (C–E after Kirkpatrick, 1888.)

### SEMIHASWELLIA (?) CLARA, new species.

Plate 66, figs. 28, 29.

*Description.*—The zoarium is free, a little compressed, formed of three rows of zooecia disposed on only one side; the dorsal is granular and bears two lateral rows of alternate salient avicularia with pivot. The zooecia are *distinct*, oval, a little elongated; the frontal is convex and ornamented with some tremopores irregularly disseminated. The peristome is salient, thin, bearing one or two very small avicularia; the peristomice is orbicular. The spiramen is placed on the median axis of the zooecium in the vicinity of the peristomice.

*Measurements.*—Peristomice $\begin{cases} hpe=0.05 \text{ mm.} \\ lpe=0.05 \text{ mm.} \end{cases}$ Zooecia $\begin{cases} Lz=0.40 \text{ mm.} \\ lz=0.30 \text{ mm.} \end{cases}$

*Affinities.*—We have only found the two specimens figured. They form a rather divergent type in this genus in the distinct form of the zooecia and in the nature of the walls. Some further study is necessary to properly classify this species.

*Occurrence.*—Middle Jacksonian: Near Lenuds Ferry, South Carolina (rare).

*Cotypes.*—Cat. No. 64168, U.S.N.M.

### Genus GIGANTOPORA Ridley, 1881.

1881. *Gigantopora* Ridley, Zoological collections made during survey of H. M. S. *Alert.* Proceedings Zoological Society London, p. 47.

The apertura bears a rimule. The frontal is an olocyst. The spiramen is inconstant; it is almost as large as the apertura.

*Genotype.—Gigantopora lyncoides* Ridley, 1881.
*Range.*—Jacksonian—Recent.

### GIGANTOPORA FILIFORMIS, new species.

Plate 66, figs. 30–35.

*Description.*—The zoarium is free, *filiform*, somewhat compressed, bifurcated, with two rows of alternate zooecia on the anterior face; the dorsal is smooth and convex. The zooecia are indistinct; the frontal is smooth and little convex. The apertura is formed of a semilunar anter and of a straight proximal border notched by a small linear rimule; the peristomie is formed by two large lateral peristomial avicularia, which can be transformed into bifurcated spines. An arch which unites these two avicularia separates the peristomice from the spiramen. The hyperstomial ovicell is small, globular, smooth.

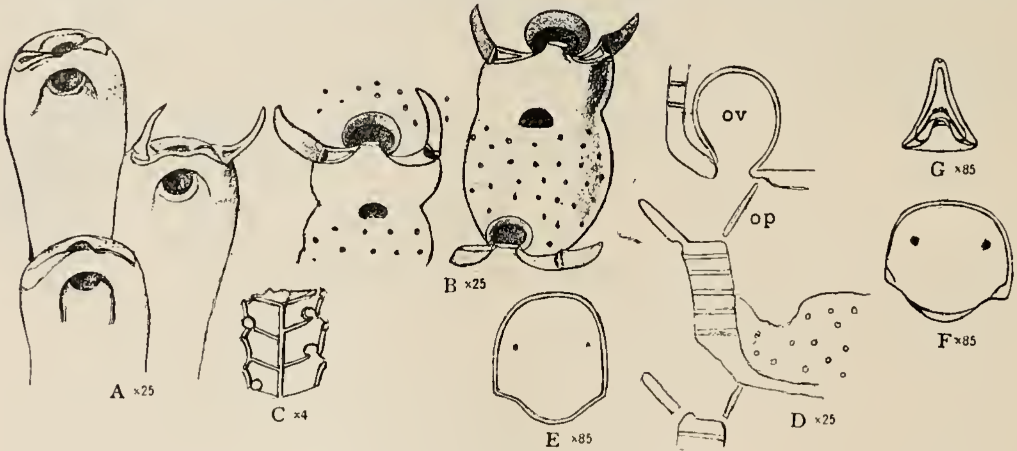


Fig. 153.—Genus *Gephyrophora* Busk, 1884.

A–G. *Gephyrophora polymorpha* Busk, 1884. A. Zooecia, × 25. (After Busk, 1884.) B. Zooecia, × 25. C, D. Longitudinal section, × 4 and × 25, showing the ovicell (*ov*) opening in the peristomie above the operculum (*op*). E. Operculum, × 85. (B–E after Waters, 1889.) F, G. Operculum and avicularian mandible, × 85. (After Waters, 1887.)

*Measurements.*—Apertura $\left\{\begin{array}{l} ha=0.04 \text{ mm.} \\ la=0.04 \text{ mm.} \end{array}\right.$ Zooecia $\left\{\begin{array}{l} Lz=0.40\text{–}0.45 \text{ mm.} \\ lz=0.30 \text{ mm.} \end{array}\right.$

*Variations.*—The spiramen is rare on our specimens; some zooecia only are furnished with it (fig. 35). The dorsal (fig. 34) is smooth; nevertheless it is porous on one of our specimens. The avicularia have no pivot, but they have two lateral denticles; they are quite salient.

*Affinities.*—The mode of formation of the spiramen is identical with that of *Gigantopora lyncoides* Ridley, 1881. It differs from it in its peristomial avicularia, which are not vibraculoid and which are much larger, and in its spiramen, which is not much larger than the apertura.

*Occurrence.*—Upper Jacksonian (Ocala limestone): Chipola River, east of Marianna, Jackson County, Florida (rare).

*Cotypes.*—Cat. No. 64169, U.S.N.M.

### Genus GEPHYROPHORA Busk, 1884.

1884. *Gephyrophora* Busk, Report on the Polyzoa collected by H. M. S. *Challenger*, pt. 1, p. 67.

The apertura bears a proximal rimule. The frontal is a tremocyst.

*Genotype.*—*Gephyrophora polymorpha* Busk, 1884.

*Range.*—Tongrian—Recent.

The known species of this genus are:

*Gephyrophora polymorpha* Busk, 1884. Recent.

*Gephyrophora* (*Hippothoa*) *fenestrata* Smitt, 1872. Recent (Florida).

*Gephyrophora* (*Schizoporella*) *biturrita* Hincks, 1884. Recent.

*Gephyrophora* (*Eschara*) *tuberosa* Reuss, 1865. Rupelian.

*Gephyrophora* (*Schizoporella*) *tuberosa*, var. *angustata*, Waters, 1887. Miocene.

Levinsen thought that the ovicell was endozooecial. If this observation be confirmed the genus must be removed from this family.

### Genus TESSARADOMA Norman, 1868.

1868. *Tessaradoma* Norman, Report 38th Meeting British Association Advancement of Science, p. 309.

The apertura is provided with cardelles. The frontal is surrounded by areolae and covered by a pleurocyst. The spiramen opens at the level of the operculum. The operculum in opening closes the spiramen.

*Genotype.*—*Tessaradoma* (*Pustulopora*) *gracile* Sars, 1850.

*Range.*—Jacksonian—Recent.

In spite of Jullien's observations, the exact nature of the spiramen is still doubtful; its place and its function are not yet elucidated.

#### TESSARADOMA ORNATA, new species.

Plate 67, fig. 1.

*Description.*—The zoarium is free, compressed, formed of three longitudinal rows of zooecia and on one side only; the dorsal is a tremocyst with sulci and garnished with a row of salient avicularia with semicircular mandible. The zooecia are distinct, elongated, gibbose; the frontal is convex, smooth, surrounded by areolae and *ornamented* with one or two simple, salient avicularia. The peristome is salient and bears two small lateral avicularia; the peristomice is orbicular; the peristomie is visible exteriorly, long and very oblique. The spiramen is a large pore placed quite distant from the peristomice.

*Measurements.*—Peristomice $\begin{cases} hpe=0.09 \text{ mm.} \\ lpe=0.09 \text{ mm.} \end{cases}$ Zooecia $\begin{cases} Lz=0.60\text{–}0.75 \text{ mm.} \\ lz=0.25 \text{ mm.} \end{cases}$

*Affinities.*—The only specimen found has been figured. It is very pretty, but it has no ovicell. It much resembles *Semihaswellia clara*, but is distinguished from it in the place of the spiramen, which is much more distant from the peristomice.

It differs from *Tessaradoma grandipora* in the much smaller diameter of the peristomice (0.09 and not 0.11 mm.) and in its thin peristome, measuring 0.10 and not 0.15 mm.

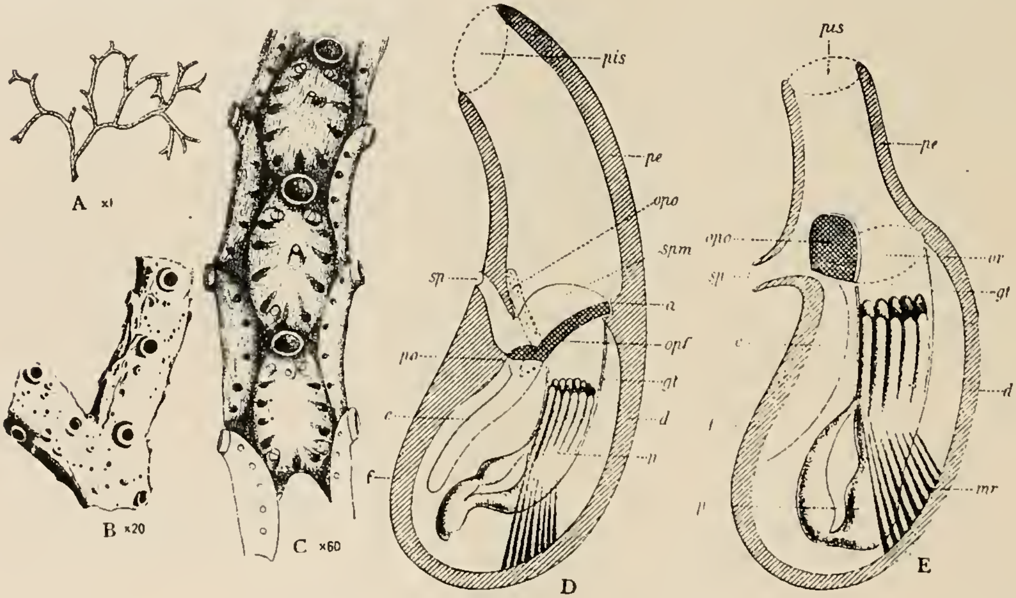


Fig. 154.—Genus *Tessaradoma* Norman, 1868.

A–G. *Tessaradoma gracile* Sars, 1850. A. Zoarium, natural size. B. Portion of zoarium, × 20. C. Zooecia, × 60. (After Hincks, 1880.) D. Schematic drawing of a longitudinal section through the zooecium. E. Drawing showing the introduction of the water by the spiramen in the peristomial tube just at the level of the operculum and above it. (B, D, E after Jullien, 1903.)

*a*, anter; *c*, compensatrix; *d*, dorsal zooecial wall; *f*, frontal zooecial wall; *gt*, tentacular sheath; *mr*, retractor muscles of the polypide; *opf*, closed operculum; *opo*, open operculum; *or*, zooecial orifice or aperture; *p*, polypide; *pe*, peristome; *pis*, peristomice; *po*, poster; *sp*, spiramen; *spm*, membraneous portion of the spiramen.

*Occurrence.*—Middle Jacksonian (Castle Hayne limestone): Wilmington, North Carolina (very rare).

*Holotype.*—Cat. No. 64170, U.S.N.M.

### **TESSARADOMA GRANDIPORA, new species.**

Plate 67, figs. 2, 3.

*Description.*—The zoarium is free, compressed, branched, formed of 3 longitudinal rows of zooecia; the dorsal is a tremocyst with sulci bearing a median row of avicularia with semicircular mandibles. The zooecia are distinct, elongated, separated by a furrow of little depth; the frontal is smooth, convex, ornamented with some lateral areolae. The peristome is large, salient, very thick, and bears two small lateral avicularia; the peristomice is orbicular; it has no peristomie, visible exteriorly. The spiramen is little distant from the peristomice; it is elongated into the form of a buttonhole.

*Measurements.*—Peristomice $\left\{\begin{array}{l} hpe=0.11\text{ mm.}\\ lpe=0.11\text{ mm.}\end{array}\right.$ Zooecia $\left\{\begin{array}{l} Lz=0.35\text{ mm.}\\ lz=0.25\text{ mm.}\end{array}\right.$

*Affinities.*—Only the two specimens figured have been found, and we, therefore, have not been able to make a detailed study of the species.

This species differs from *Tessaradoma ornata* in its spiramen which is median and close to the peristomice and in its wide peristome which may attain 0.15 mm. in diameter.

*Occurrence.*—Upper Jacksonian (Ocala limestone): West bank Sepulga River, Escambia County, Alabama (rare).

*Cotypes.*—Cat. No. 64171, U.S.N.M.

### Genus TREMOTOICHOS Canu and Bassler, 1917.

1917. *Tremotoichos* Canu and Bassler, Synopsis of American Early Tertiary Cheilostome Bryozoa, Bulletin 96, United States National Museum, p. 59.

The frontal and the dorsal are tremocysts with sulci. The spiramen opens interiorly at the level of the operculum; exteriorly it is distant from the peristomice and almost never placed on the median axis of the zooecia.

*Genotype.*—*Tremotoichos rectifurcatum* Canu and Bassler, 1917.

*Range.*—Jacksonian.

This genus possesses all the characters of *Semihaswellia*, the difference being little perceptible and consisting solely in the place of the spiramen. As the latter does not appear to exercise the same physiological function (according to Jullien) as in *Semihaswellia* we believe it necessary to create a new genus.

#### TREMOTOICHOS RECTIFURCATUM Canu and Bassler, 1917.

Plate 67, figs. 4–23.

1917. *Tremotoichos rectifurcatum* Canu and Bassler, Synopsis of American Early Tertiary Cheilostome Bryozoa, Bulletin 96, United States National Museum, p. 59, pl. 6, fig. 1.

*Description.*—The zoarium is free, subcylindrical, branched almost at a *right angle.* The dorsal is very thick; deprived of avicularia and formed of a tremocyst with tubules and with sulci. The zooecia are indistinct; the frontal is a tremocyst with sulci placed on an olocyst with very small perforations. The peristome is salient, perpendicular to the zoarial plane, thick, and provided with a small proximal avicularium; the peristomice is orbicular. The spiramen is a pore of the frontal placed on the right or left of the median axis and distant from the peristomice.

*Measurements.*—Peristomice $\left\{\begin{array}{l} hpe=0.10\text{ mm.}\\ lpe=0.10\text{ mm.}\end{array}\right.$ Zooecia.—$Lz=0.70$ mm.

*Variations.*—The spiramen is not always apparent (fig. 7); it is confused with the tremopores. The peristome of the young zooecia (fig. 5) is thin. The sulci are not always apparent on the dorsal. The peristome may bear two small avicularia (fig. 7). The branches are sometimes quite close together.

The transversal section (figs. 14, 15) shows some very thick, external walls; the tremopores are tubular and thin. The frontal abrasion (fig. 18) often makes apparent a median axis (*am*) by no means analogous to that which results from the union of the dorsal walls of the two lamellae of the Eschara; it is due to the prolonged wall of the zooecia that they are disposed as in figure 15 and that the zoarium is cut according to axis (*c*, *am*, *d*).

It is almost impossible to be successful with a longitudinal section showing the spiramen because of its eccentric position.

In a schematic one we obtain figure 16, in which it is very difficult to place the operculum. However, it is necessary to remark that the examination of the interior (fig. 20) reveals no corresponding frontal perforations. The zooecia communicate between themselves by some very apparent septules on figure 19. In thin section (fig. 17) the tubules of the tremocyst are always confused.

*Occurrence.*—Middle Jacksonian: Wilmington, North Carolina (very common); near Lenuds Ferry, South Carolina (very common).

Upper Jacksonian (Ocala limestone): Chipola River, east of Marianna, Jackson County, Florida (rare).

*Cotypes.*—Cat. Nos. 62606, 64172, U.S.N.M.

## Family HIPPOPODINIDAE Levinsen, 1909.

The frontal is calcified. The ovicell is endozooecial.

We have extended the meaning of Levinsen's definition, since we include in this family all species provided with an endozooecial ovicell. Evidently, we can not affirm that they all have the same larva, but the identity of the ovicell implies that the larvae are at least closely related.

The known genera of this family are listed below:

*Cheilopora* Levinsen, 1909.
*Hippopodina* Levinsen, 1909.
*Metrarabdotos* Canu, 1914.
*Watersipora* Neviani, 1895.

There are certainly other genera which will be referred to this family.

1. The specimens which we possess of *Escharopsis sarsi* Smitt, 1867, have endozooecial ovicells; therefore the genus *Escharopsis* Verrill, 1879, may belong to this family.

2. Levinsen[1] thought that *Flustramorpha flabelligera* Krauss, 1837, had endozooecial ovicells; therefore the genus *Flustramorpha* Busk, 1884, may be maintained and introduced into this family.

3. Levinsen[2] thought that *Harmeria diaphana* MacGillivray, 1879, was provided with endozooecial ovicells; *Harmeria* Norman may then belong to this family. The type of the genus, *Harmeria scutulata* Busk, 1855, has no known ovicell.

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[1] Morphological and Systematic Studies on the Cheilostomatous Bryozoa, p. 328.

[2] Idem, p. 316.

4. Levinsen[1] also believed firmly that *Escharina pesanseris* Smitt, 1875, had endozooecial ovicells. If this observation be confirmed, this species is the type of a new genus of this family. Waters in 1909, thought, on the contrary, that it could be placed in *Phonicosia* Jullien, 1888.

5. *Myriozoum marionense* Busk, 1884, could perhaps also belong to the same family.

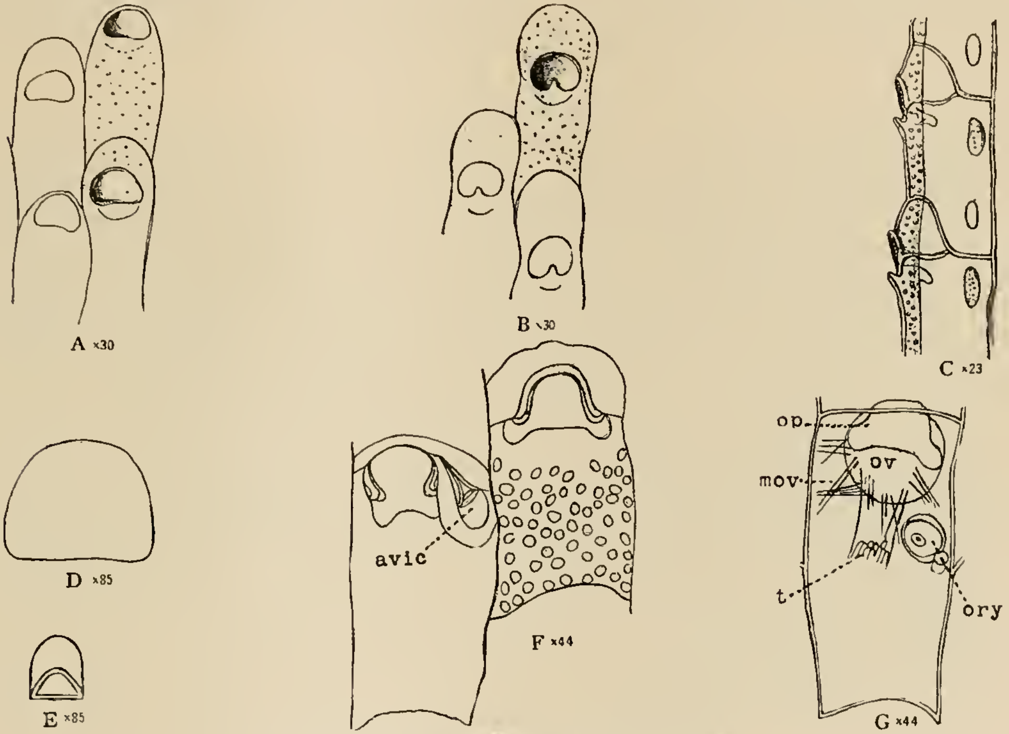

Fig. 155.—Genus *Cheilopora* Levinsen, 1909.

A–E. *Cheilopora sincera* Smitt, 1867. A, B. Ovicelled zooecia, × 30. (After Nordgaard, 1900.) C. Lateral view of two zooecia showing the septulae, × 23. (After Levinsen, 1909.) D, E. Operculum and avicularian mandible, × 85. (After Nordgaard, 1905.)

F, G. *Cheilopora haddoni* Harmer, 1902. F. Showing an avicularium and the two kinds of opercula, × 44. G. Basal views of a zooecium with trifoliate operculum, from the same slide, × 44. (F, G after Harmer, 1902.)

*avic*, avicularium; *mov*, muscles of the ovisac; *op*, operculum; *ory*, ovary; *ov*, ovisac; *t*, tentacles.

All these species require further examination and we can not yet introduce them into a regular nomenclature.

### Genus CHEILOPORA Levinsen, 1909.

1909. *Cheilopora* Levinsen, Morphological and Systematic Studies on the Cheilostomatous Bryozoa, p. 353.

The frontal is a tremocyst with pores in quincunx, not separable from the olocyst, subjacent and perforated with very small corresponding pores. Two dietellae. "The distal wall has no expansion, partly separating the ovicell from the zooecium; multiporous septulae; peristome present in the form of a lip-like projection." (Levinsen, 1909.)

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[1] Morphological and Systematic Studies on the Cheilostomatous Bryozoa, p. 326.

*Genotype.—Cheilopora* (*Lepralia*) *sincera* Smitt, 1867.

*Range.*—Aquia—Recent.

The genotype is unprovided with cardelles. We think that the species provided with cardelles and a different operculum might be introduced into a new genus.

### CHEILOPORA (?) LABIOSA Ulrich, 1901.

Plate 2, figs. 1–3.

1901. *Lepralia labiosa* ULRICH, Maryland Geological Survey, Eocene, p. 220, pl. 60, figs. 15, 16.

*Description.*—"Zoarium forming thin crusts over shells and other foreign bodies. Zooecia rhomboidal, hexagonal, or subovate arranged more or less irregularly in curved series, five or six in 2 mm., often separated by a depressed line. Front wall punctate, slightly convex, flat, or depressed, the last when the margin on one or both sides is thickened and elevated. Aperture subquadrate or semielliptical, sometimes contracted near the middle, always enclosed by a more or less strongly thickened rim. Avicularia occur on the raised apertural border, usually one to each zooecium, or two, as shown in the figures. Ooecia unknown."

The figure published by Ulrich is somewhat theoretical; notably the area as drawn is scarcely visible and only on a single zooecium of the type. We reproduce two very frequent variations. None of the specimens examined bears ovicells; our generic determination, made by analogy, necessarily remains somewhat doubtful.

The zooecia are convex, elliptical, rather little distinct. The peristome is incomplete in its proximal part; it bears laterally one or two very salient avicularia of the more simple type.

*Occurrence.*—Lowest Eocene (Bryozoan bed at base of Aquia formation): Upper Marlboro, Maryland.

*Plesiotype.*—Cat. No. 63783, U.S.N.M.

### CHEILOPORA (?) ORBIFERA, new species.

Plate 14, fig. 16.

*Description.*—The zoarium is unilamellar. The zooecia are distinct, a little elongated, lozenge-shaped; the frontal is somewhat convex and formed of a tremocyst, each pore of which is surrounded by a special *orbicular* collar quite distinct from the neighboring ones. The apertura is transverse, semielliptical; the distal half is surmounted by a peristomie with a border thin and sharp. The avicularium is lateral, provided with a pivot; its beak is turned toward the bottom.

*Measurements.*—Apertura $\begin{cases} ha = 0.10 \text{ mm.} \\ la = 0.17 \text{ mm.} \end{cases}$ Zooecia $\begin{cases} Lz = 0.80 \text{ mm.} \\ lz = 0.65 \text{ mm.} \end{cases}$

*Affinities.*—In the form of its zooecia and in the nature of its frontal this species is very close to *Cheilopora prelucidioides;* it differs, however, in the length of its peristomie, in its much larger and more numerous tremopores, and in its lateral avicularium.

The figured specimen bears no ovicell and its generic determination remains therefore somewhat doubtful.

*Occurrence.*—Claibornian (Gosport sand): Bluff on Tombigbee River, Gopher Hill, Alabama (very rare).

*Holotype.*—Cat. No. 63851, U.S.N.M.

### CHEILOPORA PRELUCIDIOIDES, new species.

Plate 68, figs. 1, 2.

*Description.*—The zoarium is free, formed of two lamellae, back to back, separating with difficulty. The zooecia are distinct, somewhat elongated, regular, elliptical, separated by a thread; the frontal is convex; the tremopores are large and are placed at the bottom of small hexagonal cavities. The apertura is large, ogival, with a proximal border, rigorously straight; the proximal border of the peristomice is somewhat convex; the peristome is complete, but salient only in its lateral and distal parts. Frequently near the apertura there are two small, simple avicularia disposed symmetrically.

*Measurements.*—Apertura $\begin{cases} ha=0.27 \text{ mm.} \\ la=0.30 \text{ mm.} \end{cases}$ Zooecia $\begin{cases} Lz=1.25 \text{ mm.} \\ lz=0.80 \text{ mm.} \end{cases}$

*Variations.*—In the interior the zooecia are lozenge-shaped, as is usual in this genus (fig. 2). They bear on their lateral walls two large, fusiform dietellae, as in the other species of *Cheilopora* with cardelles. We have not yet discovered the ovicell.

*Affinities.*—This species much resembles the recent *Cheilopora prelucidia* Hincks, 1883, living still in American waters; it differs from it only in its bilamellar zoarium and in its peristome, which is not salient in its proximal portion.

It differs from the other fossil *Cheilopora* in the absence of cardelles.

*Occurrence.*—Middle Jacksonian: Near Lenuds Ferry, South Carolina (rare).

*Holotype.*—Cat. No. 64174, U.S.N.M.

### CHEILOPORA STRICTOCELLA, new species.

Plate 68, fig. 12.

*Description.*—The zoarium is free, plurilamellar, formed of lamellae, back to back, and inseparable. The zooecia are distinct, narrow, fusiform, separated laterally by a salient thread; the frontal is somewhat convex and perforated with large tremopores in quincunx. The apertura is elongate; the anter is large and semielliptical; it is separated by two cardelles from a very small poster, of which the proximal border is convex; the peristome is incomplete, salient, and sharp. The avicularian zooecia have a very elongated orifice.

*Measurements.*—Apertura $\begin{cases} ha=0.15\text{–}0.17 \text{ mm.} \\ la=0.20\text{–}0.24 \text{ mm.} \end{cases}$ Zooecia $\begin{cases} Lz=0.85 \text{ mm.} \\ lz=0.40\text{–}0.45 \text{ mm.} \end{cases}$

*Affinities.*—We have not found the ovicell of this extremely rare species and its generic determination naturally remains somewhat doubtful.

We have already mentioned the presence of analogous avicularian zooecia in *Porella planulata* and in *Metroperiella grandipora.*

The great *narrowness* of its zooecia absolutely characterizes this species and does not permit it to be confused with any other.

*Occurrence.*—Middle Jacksonian: Near Lenuds Ferry, South Carolina (very rare); Baldock, Barnwell County, South Carolina (very rare).

*Holotype*—Cat. No. 64177, U.S.N.M.

### CHEILOPORA GRANDIS, new species.

Plate 68, figs. 3–5.

*Description.*—The zoarium is unilamellar and creeps over algae. The zooecia are very *large*, ogival, separated by a salient thread; the frontal is somewhat convex and perforated with numerous tremopores. The apertura is oval, elongated; two triangular cardelles separate a large semilunar anter from a smaller convex poster. On each side of the apertura are two salient avicularia with pivot, symmetrically placed.

*Measurements.*—Apertura $\begin{cases} ha=0.30 \text{ mm.} \\ la=0.27 \text{ mm.} \end{cases}$ Zooecia $\begin{cases} Lz=1.00\text{–}1.25 \text{ mm.} \\ lz=0.70\text{–}1.25 \text{ mm.} \end{cases}$

*Variations.*—As in all the species which are attacked by gigantism, a disease which the bryozoa as well as other organisms suffer, as shown by Larger, this also is quite variable in its micrometric measurements. Very often the zooecia are elongated, and the width oscillates between 0.70 and 0.80 mm. The length. somewhat more constant, is never lower than 1 mm. On the dorsal face of the zoarium the zooecia have exactly the form of a more or less elongated lozenge.

We are ignorant of the ovicell, but the generic determination does not offer any doubt.

*Affinities.*—This species differs from *Cheilopora saillans* in its much larger micrometric dimensions and in its unilamellar zoarium.

It differs from *Cheilopora transversa* in its elongated and nontransverse apertura.

*Occurrence.*—Middle Jacksonian: Wilmington, North Carolina (common); 3½ miles north of Grovania, Georgia (rare); 4½ miles southeast of Marshallville, Georgia (very rare).

*Cotypes.*—Cat. No. 64174, U.S.N.M.

### CHEILOPORA SAILLANS, new species.

Plate 68, figs. 9–11.

*Description.*—The zoarium is free, bilamellar, formed of two lamellae, back to back, and more or less separable. The zooecia are distinct, elongated, lozenge-shaped, separated from each other by a thick, very salient thread; the frontal is somewhat convex and formed of a tremocyst on a thin perforated olocyst. The apertura is somewhat elongated, suborbicular, and formed of a large semilunar anter and of a very convex, somewhat smaller poster; the two cardelles are prolonged in the interior as far as the lateral zooecial walls. The ovicell is endozooecial, small, little salient, transverse, of the same nature as the frontal. The two oral avicularia are orbicular, without pivot, very salient.

*Measurements.*—Apertura $\begin{cases} ha=0.16\text{–}0.18\text{ mm.} \\ la=0.16\text{–}0.18\text{ mm.} \end{cases}$ Zooecia $\begin{cases} Lz=1.00\text{ mm.} \\ lz=0.60\text{ mm.} \end{cases}$

*Variations.*—Evidently the oral avicularia are not always equally salient, but their presence is very constant.

The cardelles are very characteristic. They are prolonged as a prominence in the interior of the zooecia as far as lateral walls and thus form two powerful condyles.

That which we take for dietellae are perhaps only the cavities of the avicularia (fig. 11). We do not believe this for the following reasons:

1. In *Cheilopora prelucidioides* these cavities are visible on the specimens which have no exterior avicularium apparent.

2. In *Cheilopora saillans*, if we illuminate strongly from below the preparation showing the zooecial interior, we note that the apertura becomes naturally brilliant, but that the cavities remain dark, and that they have therefore no orifice in common with the avicularia.

Nevertheless a relationship between these dietellae and the avicularia is always possible. The width of the apertura of the ovicelled zooecia is 0.30 mm.

*Affinities.*—It is rather difficult to separate this species from *Cheilopora transversa* and *Cheilopora transversoides* in which the exterior aspect is similar, but it differs from them in its more salient avicularia and in its apertura never transverse, but always round or pyriform.

*Occurrence.*—Middle Jacksonian: Wilmington, North Carolina (common); 3¼ miles south of Perry, Georgia (rare); 17 miles northeast of Hawkinsville, Georgia (rare); one-half mile southeast of Lily, Georgia (rare).

*Cotypes.*—Cat. No. 64176, U.S.N.M.

### CHEILOPORA TRANSVERSA, new species.

Plate 69, figs. 6.

*Description.*—The zoarium is free, bilamellar, formed of two lamellae, back to back. The zooecia are distinct, lozenge-shaped, entirely surrounded by a separating, salient thread; the frontal is somewhat convex and perforated by numerous small tremopores, disposed in quincunx. The apertura is *transverse*, subelliptic, and provided with two large cardelles; the anter is less convex than the poster, but it is wider. The peristome is complete and somewhat salient. The ovicell is endozooecial, little salient, convex, transverse, of the same nature as the frontal. The two oral avicularia are a little salient, orbicular, without pivot.

*Measurements.*—Apertura $\begin{cases} ha=0.12\text{–}0.16\text{ mm.} \\ la=0.20\text{ mm.} \end{cases}$ Zooecia $\begin{cases} Lz=1.00\text{ mm.} \\ lz=0.70\text{–}0.90\text{ mm.} \end{cases}$

*Variations.*—The apertura of the ovicelled zooecia is twice as large ($la=0.40$ mm.).

In this species, as in the preceding *Cheilopora*, many of the apertures are closed by a smooth, calcareous lamella. We have examined this lamella in the interior; it is there quite distinctly visible, placed at the middle of the peristomie; it is not in direct continuity with the olocyst. We do not think that it represents a calcareous operculum, but it is probably the closure of the diseased zooecia which have lost their polypide. This is evidently only a hypothesis.

We can not affirm that the oral avicularia are true avicularia, for certain ones among them have much resemblance to the auriculate vibracula.

*Affinities.*—This species much resembles *Cheilopora saillans*, but differs from it in its quite manifestly transverse apertura.

It differs from *Cheilopora transversoides* in its nonsymmetrical apertura, in its larger micrometric dimensions, and in the very large apertura of its ovicelled zooecia.

*Occurrence.*—Middle Jacksonian: Wilmington, North Carolina (common); near Lenuds Ferry, South Carolina (rare).

*Holotype.*—Cat. No. 64179, U.S.N.M.

### CHEILOPORA TRANSVERSOIDES, new species.

Plate 68, figs. 6–8.

*Description.*—The zoarium is free, bilamellar, formed of two lamellae, back to back, and inseparable. The zooecia are distinct, elongated, lozenge-shaped, or ogival, separated by a salient thread, wide and variable; the frontal is convex and formed of a tremocyst with numerous pores placed on an olocyst finely perforated with pores corresponding to the tremopores. The apertura is transverse, elliptical, symmetrical; the anter is perceptibly equal to the poster; there are two strong median cardelles. The ovicell is endozooecial, small, little salient, convex, smooth. The two oral avicularia are small, suborbicular, little salient.

*Measurements.*—Apertura $\begin{cases} ha=0.14\text{–}0.18\text{ mm.} \\ la=0.18\text{–}0.24\text{ mm.} \end{cases}$ Zooecia $\begin{cases} Lz=0.90\text{–}1.00\text{ mm.} \\ lz=0.60\text{–}0.70\text{ mm.} \end{cases}$

*Variations.*—The apertura of the ovicelled zooecia is identical with the apertura of the ordinary zooecia.

In the interior we have observed that the two cardelles are only the extremities of two condyles, supported on the zooecial walls. The two dietellae are also very constant. The zooecial walls are very thin.

*Affinities.*—This species differs from *Cheilopora transversa* in its symmetrical apertura, in its smooth and much smaller ovicell, and in its smaller micrometric dimensions.

It differs from *Cheilopora saillans* in its transverse and not suborbicular apertura, and in its ovicells with small orifice.

*Occurrence.*—Middle Jacksonian: Wilmington, North Carolina (rare); near Lenuds Ferry, South Carolina (common); 17 miles northeast of Hawkinsville, Georgia (rare).

*Cotypes.*—Cat. No. 64175, U.S.N.M.

### CHEILOPORA SPECULA, new species.

Plate 69, figs. 1–5.

*Description.*—The zoarium incrusts bryozoa and shells. The zooecia are large, elongated, distinct, utricular; the frontal is convex, with numerous tremopores. The apertura is elliptical, transverse; the poster is as large as the anter; there are two salient cardelles; the peristome is incomplete in front; the distal part is extraordinarily developed, very long, semicylindrical. The ovicell is endozooecial, convex, globular, somewhat salient, covered with tremopores like the frontal. The two frontal avicularia are small, symmetrical, tubular.

*Measurements.*—Apertura $\begin{cases} ha=0.12\text{-}0.15\text{ mm.} \\ la=0.18\text{–}0.20\text{ mm.} \end{cases}$ Zooecia $\begin{cases} Lz=0.90\text{–}1.00\text{ mm.} \\ Lz=0.75\text{–}0.85\text{ mm.} \end{cases}$

*Variations.*—This species is quite remarkable in the great development of a part of its peristome, which forms a sort of *watchtower* above the apertura. This appendage is often lobed or bifurcated. It is very often broken on our fossils and it assumes the most varied and incoherent forms. It does not exist on the ovicelled zooecia, which bear only two long, lateral, very salient palettes. It is evident that this peristome is not in rapport with the passage of the eggs. It appears to us to be simply like an apparatus (or more exactly like a trap) destined to retain the diatoms serving as the habitual nourishment for the bryozoa. The funnel-shaped gullet which terminates it superiorly confirms this hypothesis, for it facilitates the issue of the streams of water. It is a perfect adaptation to the principle of the flow of the liquids and of their decantation. For a long time the bryozoa have invented such "spouts."

*Occurrence.*—Middle Jacksonian (Castle Hayne limestone): Wilmington, North Carolina (common).

*Cotypes.*—Cat. No. 64178, U.S.N.M.

### CHEILOPORA SULCIFERA, new species.

Plate 69, figs. 7, 8.

*Description.*—The zoarium is unilamellar and creeps on algae. The zooecia are distinct, lozenge-shaped, utricular; the frontal is convex; it is covered with tremopores often transformed into sulci. The apertura is oval, transverse; it is formed of a semilunar anter, separated by two condyles from a wide, concave and triangular rimule. The ovicell is endozooecial, small, transverse, little salient, porous. The two frontal avicularia (?) are oblique, tubular, symmetrically placed.

*Measurements.*—Apertura $\begin{cases} ha=0.15\text{ mm.} \\ la=0.15\text{–}0.18\text{ mm.} \end{cases}$ Zooecia $\begin{cases} Lz=0.90\text{–}1.00\text{ mm.} \\ lz=0.75\text{–}0.90\text{ mm.} \end{cases}$

*Variations.*—The four specimens which we have found of this species have not permitted an attentive and detailed study. We think that it may serve as type of a special genus. In fact the apertura has not the "Hippo" form of the other species of the genus, for it appears to be more "Schizo"—that is to say, with rimule; the two lateral avicularia are rather vibracula, analogous to those of *Schizoporella vulgaris* Johnston, 1847.

The zooecia are elongated (fig. 8) or transverse (fig. 7).

*Occurrence.*—Middle Jacksonian (Castle Hayne limestone): Wilmington, North Carolina (rare).

*Cotypes.*—Cat. No. 64180, U.S.N.M.

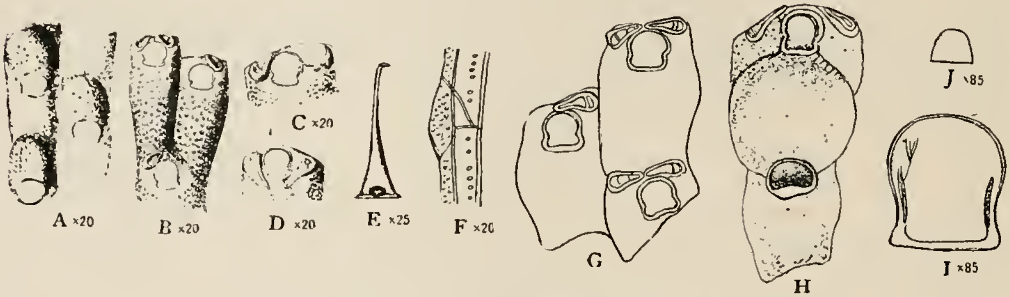

FIG. 156.—Genus *Hippopodina* Levinsen, 1909.

A–J. *Hippopodina feegeensis* Busk, 1884. A. Ovicelled zooecia, × 20. B. Zooecia without ovicell and with avicularia, × 20. C. Zooecium with another form of avicularia, × 20. D. Avicularia in another position, × 20. E. Avicularian mandible, × 25. F. A zooecium with ovicell, seen from the left side wall, × 20. (A–F after Levinsen, 1909.) G, H. Zooecia with avicularia and with large ovicell. (After MacGillivray, 1891.) I, J. Operculum and avicularian mandible, × 85. (After Waters, 1913.)

## Genus HIPPOPODINA Levinsen, 1909.

1909. *Hippopodina* LEVINSEN, Morphological and Systematic Studies on the Cheilostomatous Bryozoa, p. 353.

The apertura is provided with two cardelles. The frontal is a tremocyst placed on a finely perforated and very thin olocyst. The ovicell is endozooecial. "The horizontal part of the distal wall is continued into an expansion which forms a partial partition between the ovicell and the zooecium; uniporous septulae; no peristome." (Levinsen, 1909.)

*Genotype.*—*Hippopodina* (*Lepralia*) *feegeensis* Busk, 1884.

*Range.*—Jacksonian—Recent.

### HIPPOPODINA VIBRACULIFERA Canu and Bassler, 1917.

Plate 69, figs. 9–14.

1917. *Hippopodina vibraculifera* CANU and BASSLER, Synopsis of American Early Tertiary Cheilostome Bryozoa, Bulletin 96, United States National Museum, p. 61, pl. 5, fig. 8.

*Description.*—The zoarium is free, bilamellar; the two lamellae, back to back, are easily separated. The zooecia are elongated, large, hexagonal; the frontal is convex and formed of a tremocyst with very numerous pores placed on a very finely perforated olocyst, from which it is separable. The apertura is formed of a very large orbicular anter and of a narrower poster with proximal lip straight and denticulated; the vestibular arch is clearly visible. The endozooecial ovicell is immense and takes the place of a zooecium; it is convex and perforated with tremopores; the apertura of the ovarian zooecia is much larger. Two auriculate *vibracula* are placed symmetrically on the distal part of the zooecia.

*Measurements.*—Apertura $ha=0.25$ mm.
of ordinary zooecia $la=0.28$ mm.
Apertura of ovarian zooecia $\begin{cases} ha=0.25 \text{ mm.} \\ la=0.35 \text{ mm.} \end{cases}$
Zooecia $\begin{cases} Lz=0.90\text{–}1.10 \text{ mm.} \\ lz=0.80\text{–}1.00 \text{ mm.} \end{cases}$

*Variations.*—Numerous zooecia are closed at the level of the vestibular arch by a sort of finely perforated operculum. They probably do not contain a polypide, which perhaps died of disease.[1] The phenomenon is frequent in the family. The two superposed frontals are clearly visible in figure 12; the tremopores are tubular (fig. 11).

The vibracula are quite constant. We think that the zoarium was not fixed at the bottom of the seas; that it was attached to the algae, and that the vibracula assure stabilization. There were five septulae.

*Occurrence.*—Middle Jacksonian: Wilmington, North Carolina (common); 3½ miles north of Grovania, Georgia (very rare).

Upper Jacksonian (Ocala limestone): Old Factory, 1½ miles above Bainbridge, Georgia (rare).

*Cotypes.*—Cat. No. 62604, U.S.N.M.

### Genus METRARABDOTOS Canu, 1914.

1914. *Metrarabdotos* Canu, Bryozoaires des Terrains du Sud-Ouest de la France, Bulletin Société Géologique, France, vol. 14, p. 472.

The ovicell is endozooecial. The apertura is semilunar, with a rimule and lyrula. The frontal is surrounded with lateral areolae and formed of an olocyst surmounted by a pleurocyst.

*Genotype.*—*Metrarabdotos* (*Eschara*) *moniliferum* Milne-Edwards, 1836.

*Range.*—Priabonian-Astian.

#### METRARABDOTOS MONILIFERUM Milne-Edwards, 1836.

Plate 98, figs. 1–10.

1836. *Eschara monilifera* Milne-Edwards, Recherches anatomiques, physiologiques et zoologiques sur les Eschares, Annales Sciences Naturalles Zoologie, ser. 2, vol. 6, p. 27, pl. 9, fig. 1.

1844. *Eschara punctata* Philippi, Beiträge zur Kenntniss der Tertiärversteinerungen des nordwestlichen Deutschlands, pp. 38, 68, pl. 1, fig. 19.

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[1] For the paleopathology the reader should consult the following: 1913–1916. Dr. René Larger. La contre evolution ou dégénérescence par l'hérédité pathologique cause naturelle de l'extinction des groupes animaux. Essai de paléopathologie générals comparée, Bulletin et Mémoires de la Société d'Anthropologie de Paris, 1913.

1845. *Eschara monilifera* Michelin, Iconographie zoophytologique: Description par localités et terrains des Polypiers fossiles de France et pays environnants, Paris, p. 327, pl. 78, fig. 10.

1847. *Eschara punctata* Reuss, Die fossilen Polyparien des Wiener Tertiärbeckens, Haidinger's naturwissenschaftliche Abhandlungen, vol. 2, Wien, p. 691, pl. 8. fig. 25.

1851. *Eschara punctata* Reuss, Ein Beitrag zur Paleontologie der Tertiärschichten Oberschlesiens, Zeitschrift Deutschen Geologischen Gesellschaft, vol. 3, p. 164.

1859. *Eschara monilifera* Busk, A Monograph of the Fossil Bryozoa of the Crag, Publications of the Paleontological Society of London, p. 68, pl. 11, figs. 1–3.

1861. *Eschara monilifera* Stoliczka, Oligocäne Bryozoen von Latdorf en Bernburg, Sitzungsberichte der k. Akademie der Wissenschaften, Wien. vol. 45. Abth. 1, p. 88.

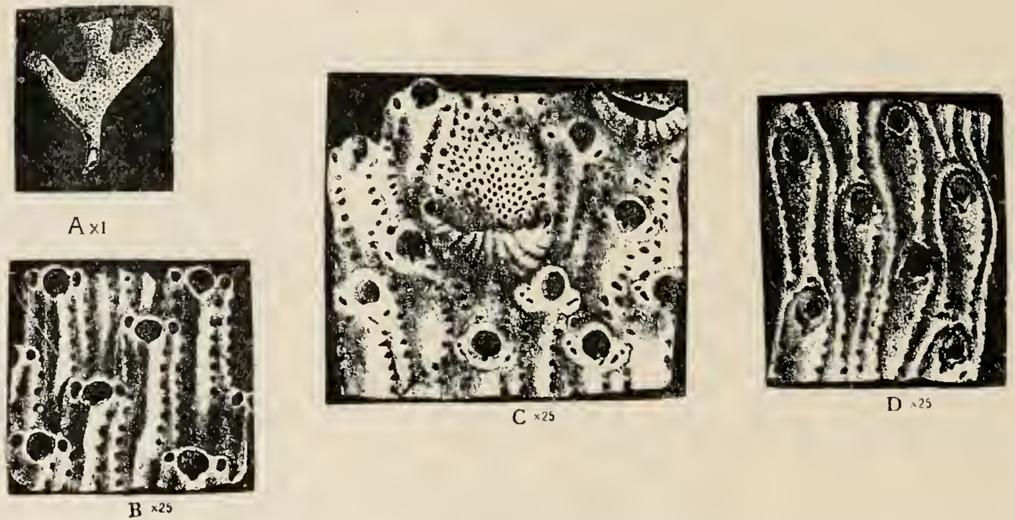


FIG. 157.—Genus *Metrarabdotos* Canu, 1914.

A–D. *Metrarabdotos moniliferum* Milne Edwards, 1836. A. Zoarium, natural size. B. Zooecia with avicularia, × 25. C. Zooecia showing ovicell, × 25. D. Zooecia with neither ovicells nor avicularia, × 25. (A–D after Busk, 1859.)

1862. *Escharella micropora* Gabb and Horn, Monograph of the fossil Polyzoa of the Secondary and Tertiary Formations of North America, Journal Academy Natural Sciences, Philadelphia, ser. 2, vol. 5, p. 136, pl. 19, fig. 17.

1864. *Eschara monilifera* Stoliczka, Fossile Bryozoen aus dem tertiären Grünsandsteine der Orakei-Bay bei Aukland, mit Betrachtungen über neue oder weniger bekannte Bryozen-Sippen und deren Classification, Reise der Oest. Fregatte *Novara*, geol. Theil, vol. 1, Abth. 2, Paleontologie, p. 32, pl. 19, figs. 15, 16.

1864. *Eschara monilifera* Reuss, Zur Fauna des deutschen Oberoligocäns, Abth. 2, Sitzungsberichte der k. Akademie der Wissenschaften, Wien, vol. 50, p. 35.

1866. *Eschara monilifera* Reuss, Ueber die Foraminiferen, Anthozoen und Bryozoen des deutschen Septarienthones, Denkschriften der k. Akademie der Wissenschaften, Wien, vol. 25, Abth. 1, p. 182 (sep. 66).

1876. *Eschara monilifera* Manzoni, I Briozoi fossili del miocene d'Austria ed Ungheria, Denksch. math.-natur. Classe der k. Akademie der Wissenschaften, Wien, vol. 37, Abth. 2, p. 59, pl. 5, fig. 20; pl. 6, fig. 21.

1880. *Eschara monilifera* Seguenza, Le formazioni terziarie nella Provincia di Reggio (Calabria), Reales Accad. Lincei, Memorie della Classe di Sci. Fisiche, Matemat. Nat., Roma, ser. 3, vol. 6, pp. 131, 208, 371.

1883. *Eschara monilifera* Fuchs, Beiträge zur Kenntniss der miocaenfauna Ègyptens und der libyschen Wüste (Oase Sinah), Palaeontographica, vol. 19, p. 34, pl. 13, fig. 8.

1883. *Eschara monilifera* Pergens, Les Bryozoaires du Tasmajdan à Belgrado, Séances Soc. Roy. Malacologique de Belgique, vol. 22, p. 9.

1887. *Eschara monilifera* Pergens, Note préliminaire sur les Bryozoaires fossiles des environs de Kolosvar, Bull. Séances Soc. Roy. Malacologique de Belge, p. 7.

1887. *Eschara monilifera* Pergens, Pliocäne Bryozoen von Rhodes, Ann. des k. k. naturhist. Hofmuseums, Wien, vol. 2, p. 27.

1889. *Eschara monilifera* Pergens, Zur fossilen Bryozoenfauna von Wola Lu' zanska, Bulletin Société Belge Géologie, vol. 3, Mémoires, p. 70.

1891. *Escharoides monilifera* Neviani, Cont. alla conoscenza dei Briozoi fossili ital, Bri. postpliocenici del sottosuolo di Livorno, Bull. della Soc. Geol. Ital., Roma, vol. 10, p. 125 (sep. 29).

1892. *Eschara monilifera* Van Der Broeck, Bulletin de la Société Belge de Géologie, p. 5.

1894. *Escharoides monilifera* Neviani, Terza Cont. alla conoscenza dei Briozoi fossili ital, Di alcuni Briozoi pliocenici del Rio Landa, illustrati da Ferdinando Bassi nel, 1757, Boll. Soc. Geol. Ital., Roma, vol. 13, p. 667 (sep. 11).

1895. *Lepralia monilifera* MacGillivray, A Monograph of the Tertiary Polyzoa of Victoria, Transactions Royal Society Victoria, vol. 4, p. 76, pl. 14, fig. 28.

1895. *Escharoides monilifera* De Angelis, Descripcion Briozoos fosiles Pliocenicos de Cataluna, Vertida del Latin por el Rio. Canonigo Dr. D. Jaime Almera, Barcelona, p. 16, pl. B, fig. 13.

1895. *Schizoporella monilifera* Neviani, Briozoi neozoici di alcune localita d. Italia, Bollettina Societá Romana per gli Studi Zool., vol. 2, p. 238 (14).

1896. *Schizoporella monilifera* Neviani, Briozoi neozoici di alcune località d'Italia, Bollettina Societá Romana per gli Studi Zool., vol. 3, p. 122 (sep. 21).

1897. *Schizoporella monilifera* Neviani, Corallari i Briozoi neogenici di Sardegna, Bollettino Societá Geologica Italia, Roma, vol. 15, p. 587.

1898. *Escharoides monilifera* De Angelis, Los primeros antozoos y Briozoos miocenicos recogidos en Cataluña, Memorias de la Real Academia de Ciencias y Artes de Barcelona, p. 24.

1898. *Escharoides monilifera* Neviani, Briozoi neozoici di alcune località d'Italia, Bollettino Societá Romana per gli Studi Zool., pt. 5, pp. 7, 13.

1900. *Schizoporella monilifera* Neviani, Briozoici neozoici di alcune località d'Italia, Bollettino Societá, Róma per gli Studi Zool., pt. 6, (2) 1, p. 4.

1900. *Schizoporella monilifera* Neviani, Briozoi Terziari i Posterziari della Toscana, Bollettino Societá Geologica Italia, vol. 19, p. 22.

1900. *Schizoporella monilifera* Neviani, Briozoi neogenici dele Calabrie, Paleontographia italiana, vol. 6, p. 197 (sep. 83).

1912. *Schizoporella monilifera* Canu, Bryozoaires helvétiens de l'Égypte, Memoires de l'Institut égyptien, vol. 6, p. 210.

1914. *Metrarabdotos moniliferum* Canu, Bryozoaires des Terrains du Sud-Ouest de la France, Bulletin Société Géologique, France, vol. 14, p. 472.

*Historical.*—In 1912, Canu published the bibliography of only the illustrated forms, but now we publish a complete bibliography. The generic determination has varied little and corresponds to the general ideas of each time. Before 1895, the species was known as *Eschara*, the classification being zoarial. The influence of Hincks and the introduction of the knowledge of the hydrostatic system then caused it to be classified in *Schizoporella*. In 1914, the recognition of the ovicell system obliged Canu to create a new genus in which he classed in addition *Metrarabdotos* (*Eschara*) *polymorphum* Reuss, 1869.

This species made its appearance in Europe in the uppermost beds of the Priabonian; it does not exist in the bryozoan marl of the Priabonian. Its occurrence is therefore valuable for the synchronism of the American formations, and it confirms the equivalence of the Vicksburgian with the Tongrian. It appears to be exterminated in the Upper Pliocene.

*Variations.*—This species has not remained exactly identical, throughout its long geologic persistence. The ovicell of the specimens from the English Crag (Pliocene) is hardly costulate; the costules are quite visible and very clear in the French Miocene; they are finally very salient and quite vigorous in our American specimens. These variations do not seem to us of specific order, for the calcification of the zoaria depends much on the richness of the waters in lime.

The restoration which we have attempted (fig. 1) indicates a ramose zoarium branching dichotomously in the same plane; its total length seldom exceeds 3 or 4 centimeters.

The sinus of the apertura shows a small, very fragile lyrula whose function is unknown for it does not appear identical with the lyrula of *Smittina*.

The zooecia are convex (fig. 3) or marginate (fig. 2); but always bordered with numerous and triangular, large areolae generally visible in the interior (fig. 6).

The frontal of the ovicell (fig. 5) is very fragile and moreover often wanting on the fossils. The longitudinal section (fig. 10) is the habitual section of the endozooecial ovicells; the larvae ought to be very large. The orifice of the ovicelled zooecia is three times larger ($la$=0.30 instead of 0.10 mm.) than the apertura of the ordinary zooecia. The tangential section (fig. 8) shows by its lateral reticulations and its sinous median line, the presence of a pleurocyst reposing on the olocyst; but this appears very thin and is never seen exteriorly.

*Measurements.*—Apertura $\begin{cases} ha=0.08 \text{ mm.} \\ la=0.10 \text{ mm.} \end{cases}$ Zooecia $\begin{cases} Lz=0.60 \text{ mm.} \\ lz=0.30\text{–}0.36 \text{ mm.} \end{cases}$

Maximum width of the fronds =2 mm.

*Occurrence.*—Vicksburgian (Marianna limestone): One mile north of Monroeville, Alabama (very common): near Claiborne, Monroe County, Alabama (common): 2½ miles north of Millry, Washington County, Alabama (rare): Vicksburg, Mississippi (common in the lower beds).

*Geological distribution.*—Priabonian of Transylvania and Galicia (Pergens). Latdorfian of Germany (Reuss, Stoliczka). Rupelian of Germany (Reuss). Chattian of Germany (Reuss). Burdigalian of Spain (DeAngelis), of the Gard (Canu). Helvetian of Touraine (Michelin), of Spain (DeAngelis). Tortonian of Servia (Pergens), of Austria-Hungary (Reuss), of Italy (Seguenza). Sahelian of Oran (Coll. Canu). Zancleen of Italy (Seguenza). Plaisancian of Italy (Seguenza, Neviani), of England (Busk), of Belgium (Van den Broeck). Astian of Italy (Seguenza), of Belgium (Van den Broeck). Miocene of Australia (MacGillivray) and of New Zealand (MacGillivray).

*Plesiotypes.*—Cat. No. 64316, U.S.N.M.

### METRARABDOTOS GRANDE, new species.

Plate 98, figs. 11–15.

*Description.*—The zoarium is free, arborescent, branched dichotomously in the same plane. The fronds are narrow, compressed, often twisted. The zooecia are elongated, distinct, fusiform, the frontal is convex, surrounded by areolae, and formed of a granular pleurocyst united to the olocyst. The apertura is oval and formed of a semilunar anter and of a broad, triangular rimule, in which a very small lyrula is placed. The peristome is hardly salient. The ovicell is endozooecial, enormous, with a frontal ornamented with larger, radial costules.

*Measurements.*—Apertura $\begin{cases} ha = 0.10 \text{ mm.} \\ la = 0.10 \text{ mm.} \end{cases}$ Zooecia $\begin{cases} Lz = 0.90 \text{ mm.} \\ lz = 0.24 \text{ mm.} \end{cases}$

Width of branches=3 to 5 mm.

*Variations.*—The zoarium bears some tuberosities (fig. 15), partitioned in the interior, which serve perhaps as zoarial hydrostatic apparatus.

The frontal walls of the zooecium are very thick (fig. 15), whereas the lateral walls are quite thin (fig. 14).

This species is very abundant in the locality in Jasper County, Mississippi. It alone numbers many more specimens than all the others combined and constitutes almost alone the Cheilostome fauna of this locality. It occurs here in clay, which habitat it seems to prefer. This is also the case in the *Metrarabdotos polymorphum* Reuss, 1869, which lived in France in the clay of Gaas.

We have attempted a restoration of this remarkable species: the zoarium must attain from 7 to 10 centimeters in length.

*Affinities.*—This species differs from *Metrarabdotos moniliferum* Milne-Edwards, 1836, in its longer zooecia ($Lz=0.90$ instead of 0.60 mm.), in the absence of small oral avicularia, and in a much larger zoarium, and with wider fronds (3–5 mm. instead of 2 mm.).

*Occurrence.*—Vicksburgian (Marianna limestone): Three miles southeast of Vosburg, Jasper County, Mississippi (very common).

Vicksburgian (Red Bluff clay): Seven and one-half miles southwest of Bladen Springs, Alabama (rare); Red Bluff, Wayne County, Mississippi (rare).

*Cotypes.*—Cat. No. 64317, U.S.N.M.

### Genus WATERSIPORA Neviani, 1895.

1895. *Watersipora* NEVIANI, Briozoi neozoici di alcune locatità d'Italia, Bollettino della Società Romana per gli Studi Zoologici, pts. 2, 4, p. 231.

The operculum is membranous or very slightly chitinous on the borders: it exhibits a chitinous axial band of a brown color, marking out from the rest of the operculum two lateral spaces, which are clearer and which correspond to the two powerful cardelles borne by the zooecial orifice. The frontal is a tremocyst. 23–24 tentacles.

*Genotype.*—*Watersipora* (*Lepralia*) *cucullata* Busk, 1853, variety *labiosa* Calvet, 1903.

*Range.*—Helvetian—Recent.

The genotype is quite variable; the published figures resemble it but little because of the very irregular development of the two labial appendages of the aperture. In 1895 Neviani, ignoring the operculum, created for it a subgenus of *Smittia* under the name of *Watersipora*. The great difference of the operculum by its rigor may justify the existence of a new genus, although the function remains identical. Moreover, in order to preserve the genus, it will be necessary to complete the description by further studies.

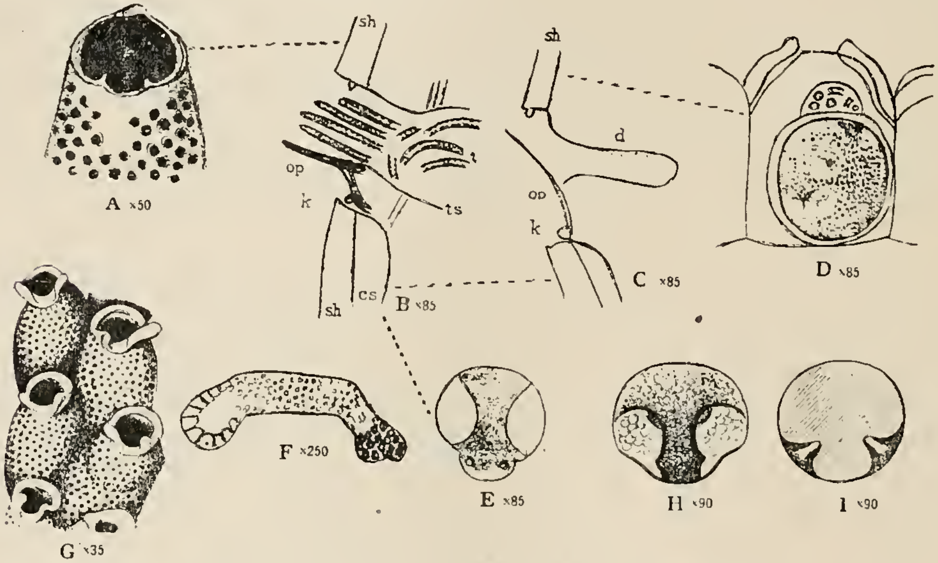


Fig. 158. Genus *Watersipora* Neviani, 1895.

A–I. *Watersipora cucullata* Busk, 1853. A. Zooecium, × 50. B. Section of aperture with (*cs*) compensatrix, (*k*) knob of operculum, (*op*) operculum open, (*sh*) frontal walls of zooecium, (*t*) tentacles, (*ts*) tentacular sheath; × 85. C. Aperture with operculum nearly closed; (*d*) diaphragm, × 85. D. Transverse section of a zooecium near the distal end, showing the larva near the base of the zooecium, × 85. E. Operculum membraneous or somewhat chitineous, × 85. F. Commencement of glands growing on the operculum, × 250. (A–F after Waters, 1909.) G. Zooecia of var. *labiosa* Calvet, 1903, × 35. H. Operculum of var. *labiosa*, × 90. I. Apertura of var. *labiosa*, × 90. (G–I after Calvet, 1903.)

### WATERSIPORA (?) ERECTA, new species.

Plate 69, fig. 15.

*Description.*—The zoarium is free, *erect*, with two lamellae, back to back. The zooecia are elongated, little distinct; the frontal is smooth and little convex. The aperture is buried at the bottom of a peristomie; it is irregular and formed by the development of two lateral lips, separated by a pseudorimule. No avicularia.

*Measurements.*—Zooecia $\begin{cases} Lz = 0.50 \text{ mm.} \\ lz = 0.25 \text{ mm.} \end{cases}$

*Affinities.*—Only the figured specimen has been found; it bears no ovicell. It differs from the type of the genus in its smooth and nonporous frontal and in its zoarium, which is free and does not incrust algae.

*Occurrence.*—Upper Jacksonian (Ocala limestone): Alachua, Florida (rare).

*Holotype.*—Cat. No. 64181, U.S.N.M.

## Family TUBUCELLARIIDAE Busk, 1884.

*Bibliography (Anatomical).*—1907. Waters, Tubucellaria: its Species and Ovicells, Journal Linnean Society, London, Zoology, vol. 30, p. 126, pls. 15, 16.—1909. Levinsen, Morphological and systematic studies on the Cheilostomatous Bryozoa, p. 304, pl. 16, figs. 3, 4, 5.

The zooecia have no spines; their frontal is formed of long tremocystal tubules surmounting a thin perforated olocyst. The septulae are numerous, scattered, and multiporous. The ovicell is vestibular, being formed by a great expansion of the peristomie, which is always very long. The frontal bears an ascopore opening into the compensation sac.

*Terminology.*—The very considerable thickening of the frontal develops a very long *peristomie*, the lower orifice of which is closed by the operculum and forms the true *apertura;* its outer orifice is the *peristomice*, which is more irregular in form. The latter is surrounded by a more or less thickened and salient *peristome*. Exteriorly, the upper part of the zooecia, which corresponds to the peristomie, is the *peristomiale*.

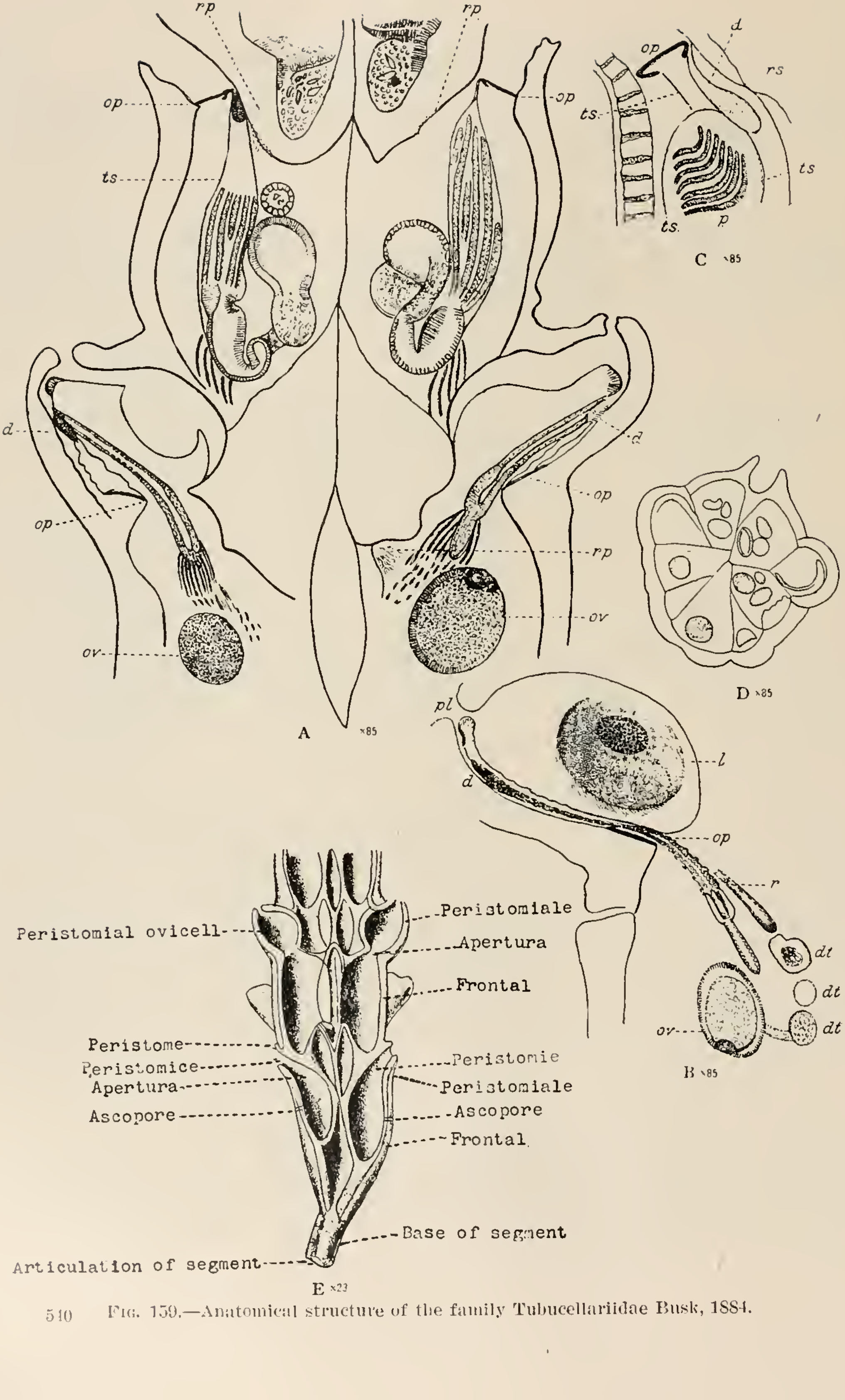
*Anatomical structure.*—The zooecia are provided with closely placed pits or areas separated by ridges, each surrounding a pore. This disposition is the rule when the tremocyst covers a perforated olocyst. These pits or areas are the extremities of well developed tubules, as in the family Myriozoumidae.

The ovicelled zooecia have a particular form like the gonoecia of the Adeonidae; but they have not at all the same structure. The larvae develop in a large expansion of the peristomie, forming a peristomial ovicell. In its interior, there is at first a normal polypide. This disappears by histolysis and a diminutive and very vigorous polypide succeeds it, in which the circular canal and the ganglion may be observed. This communicates with the opening of the ovicell and is accompanied by a voluminous ovary.

The diaphragm (irisoid) is attached to the operculum and to the wall.

There is a large number of delicate muscles attached to the compansation sac, and the latter communicates with the exterior by the ascopore.

The zoarium is free, unilamellar, bilamellar, or cylindrical. It is often articulated and radicellated. The articulated zoarium generally lives among algae, the mobility and flexibility of which it must share.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B ×85
Peristomial ovicell
Peristomiale
Apertura
Frontal
Peristome
Peristomice
Apertura
Peristomie
Peristomiale
Ascopore
Ascopore
Frontal
Base of segment
Articulation of segment
E ×23

FIG. 159.—Anatomical structure of the family Tubucellariidae Busk, 1884.

FIG. 159.—Anatomical structure of the family Tubucellariidae Busk, 1884.

A–D. *Tubucellaria cereoides* Ellis and Solander var. *chuakensis* Waters, 1907. A. Section through two ordinary polypides and two peristomial ovicells. This is an absolute copy of one section, though in two or three cases where the operculum had not been well cut through that detail had to be taken from the following section. In the peristomial ovicell the plug is seen withdrawn from the opening, but this may only be the result of decalcification and preparation as changes are sure to take place when the calcareous support is removed. The operculum (*op*) has opened the peristomial ovicell for the passage of the diminutive polypide, and the position of the tentacular sheath (*ts*) and diaphragm (*d*) can be followed. In this case there is no larva in the ovicell, but apparently there has been one and the ovaria (*ov*) would probably soon furnish others. The parenchym passing through the rosette plate is seen at *rp;* × 85. B. Section of the peristomial ovicell containing a larva (*l*). The diminutive polypide is shown and the plug (*pl*) to close the opening; also the remains of the rectum (*r*) and the encysting portions of the digestive tube (*dt*) are cut through. The ovarium (*ov*) is immediately below the diminutive polypide, and there are parenchym threads (mesenchyme) from it to one of the cysts. This apparently shows an earlier stage than fig. A, as we still have the indications of the complete polypide; × 85. C. Section showing the diaphragm (*d*) retracted; *op*, operculum; *ts*, tentacular sheath; *rs*, septulae; *p*, polypide folded in the zooecium; × 85. D. Transverse section showing compensatrix, × 85. (A–D after Waters, 1907.)

E. *Tubucellaria opuntioides* Pallas, 1766. Longitudinal section of a zoarium, × 25, introduced to show terminology. (After Levinsen, 1909.)

*Generic Table.*

| | |
|---|---|
| Zoarium articulated. No avicularia | *Tubucellaria.* |
| Zoarium fixed, bilamellar. Avicularia very rare | *Tubucella.* |
| Zoarium unilamellar. Avicularia on each zooecium | *Tubiporella.* |

The prefix "tub" might well remain the characteristic of the family in the creation of new genera.

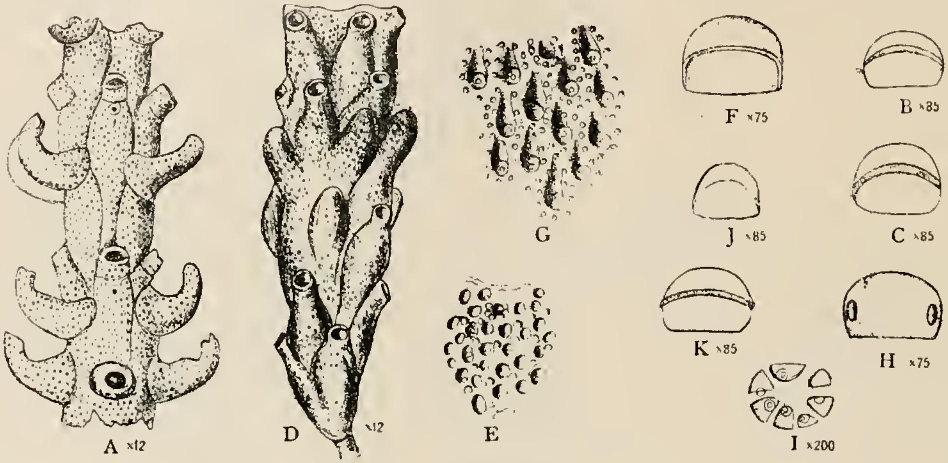

Fig. 160.—Genus *Tubucellaria* D'Orbigny, 1852.

A–C. *Tubucellaria cereoides* Ellis and Solander, 1786. A. Portion of a zoarium, × 12. B. Operculum, × 85. C. Operculum of var. *ehuakensis* Waters, 1907, × 85. (A–C after Waters, 1907.)

D–F. *Tubucellaria opuntioides* Pallas, 1766. D. Portion of a zoarium, × 12. E. Aspect of the surface of a zooecium. The ascopore is seen distally. F. Operculum, × 75. (D–F after Levinsen, 1909.)

G–I. *Tubucellaria hirsuta* Lamouroux, 1816. G. A part of the surface of the zooecium. The ascopore is seen distally. H. Operculum, × 75. I. A separating wall with septulae, the position of which is at the proximal end of each of the thread-shaped appendages; × 200. (G–I after Levinsen, 1909.)

J. *Tubucellaria zanzibarensis* Waters, 1907. Operculum, × 85.

K. *Tubucellaria fusiformis* D'Orbigny, 1852. Operculum, × 85. (J, K after Waters, 1907.)

### Genus TUBUCELLARIA D'Orbigny, 1852.

1852. *Tubucellaria* D'Orbigny, Paléontologie française, Terrain Cretace, vol. 5, Bryozoaires, p. 335.

The zoarium is articulated and radicellated. The operculum is simple and separable. No vestibular arch, no avicularia. 22–27 tentacles.

*Genotype.—Tubucellaria* (*Cellaria*) *cereoides* Ellis and Solander, 1786.

*Range.*—Lutetian—Recent.

The oldest species is *Tubucellaria fragilis* Michelin, 1845, from the French Lutetian. In Europe the known Oligocene species are rather confused and do not permit useful comparisons with the American forms; their occurrence, moreover, is very rare.

### TUBUCELLARIA PARVIPOROSA, new species.

Plate 70, figs 1–4.

*Description.*—The zoarium is articulated; the segments are cylindrical and very long. The zooecia are much elongated, distinct, fusiform; the frontal is convex and covered with *small* closely arranged pores; the peristomiale occupies the upper fourth of the zooecia and is separated from the frontal by a small furrow. The peristome is round, little thickened, salient, arranged obliquely or normally on the segment. The ascopore is situated on the frontal below the peristomiale. The ovicelled zooecia have a much larger external aperture.

*Measurements.*—Zooecia $\begin{cases} Lz=1.30 \text{ mm.} \\ lz=0.40 \text{ mm.} \end{cases}$ Peristome=0.22 mm.

*Affinities.*—The system of branching is the same as in *Tubucellaria fallax;* but *T. parviporosa* is distinguished from that species by its much smaller frontal pores and by its greater zooecial length (1.30 mm. instead of 1.10 mm.).

It differs from *Tubucellaria vicksburgica* in its smaller pores, its less zooecial length (1.30 mm. and not 1.40 mm.), and in its system of branching not borne on a large calcareous process.

We have observed a closed zoœcium in which only the ascopore persists. What could be its physiologic use in the absence of the polypide?

*Occurrence.*—Middle Jacksonian: Baldock, Barnwell County, South Carolina (common).

*Cotypes.*—Cat. No. 64182, U.S.N.M.

### TUBUCELLARIA FALLAX, new species.

Plate 70, figs. 5–10.

*Description.*—The zoarium is articulated; the segments are cylindrical and short. The zooecia are elongated, distinct, fusiform; the frontal is convex and covered with polygonal pores: the peristomiale occupies the upper fourth of the zooecia and is not separated from the frontal. The peristome is round, thin, salient, and arranged very obliquely to the segment. The ascopore is situated on the frontal below the vestibular area. The ovicelled zooecia have a much larger external aperture.

*Measurements.*—Zooecia $\begin{cases} Lz=1.10 \text{ mm.} \\ lz=0.35 \text{ mm.} \\ \text{Peristome}=0.20\text{–}0.25 \text{ mm.} \end{cases}$

Peristomice $\begin{cases} \text{Ovicelled zooecia}=0.20 \text{ mm.} \\ \text{Ordinary zooecia}=0.12 \text{ mm.} \end{cases}$

*Variations.*—The articulation in the American species is rather different from that which we have observed on the recent forms. On the latter, in the immediate neighborhood of the peristome, there is a large pore or sort of chitinous joint which maintains the upper segment. On *Tubucellaria fallax* and *T. parviporosa* there are two pores in the vicinity of the external aperture, and the zooecia which bear them are not provided with an ascopore. We have as yet collected no segment preserving the base, and we are therefore ignorant of the signification of these pores. It may be presumed that one pore is intended for the chitinous joint and the other for a radicell (figs. 6, 7).

The tubules in becoming elongated also increase the diameter of the segments and the width of the zooecia (figs. 8, 9); but this is a very rare variation. The peristomiale presents pores a little larger and arranged at the base of longitudinal canals.

The ovicells are large convexities, of which the external apertures (0.20 mm.) are much larger than those of the ordinary zooecia (0.12 mm.).

At the locality near Perry, Georgia, a segment was found with large pores and with very thick peristomes, which we think belongs to this species (fig. 10), but of this we are not absolutely certain.

*Affinities.*—This species differs from *Tubucellaria parviporosa* in having somewhat larger pores and much shorter zooecia ($lz$=1.10 mm. instead of 1.30 mm.). It may be distinguished from *Tubucellaria vicksburgica* by its smaller frontal pores, its shorter zooecia (1.10 mm. instead of 1.40 mm.), and by its system of articulation, which does not have a very salient process.

This species is rather *deceiving* in its quite variable external aspect. It may only be determined with certainty by the aid of micrometric measurements; it is the smallest of the American *Tubucellaria.*

*Occurrence.*—Middle Jacksonian: 18 miles west of Wrightsville, Johnson County, Georgia (rare); 3¼ miles south of Perry, Georgia (rare); one-half mile southeast of Georgia Kaolin Co. mine, Twiggs County, Georgia (rare); 17 miles northeast of Hawkinsville, Georgia (very rare).

Upper Jacksonian (Ocala limestone): West bank Sepulga River, Escambia County, Alabama (rare).

*Cotypes.*—Cat. Nos. 64183–64185, U.S.N.M.

### TUBUCELLARIA VICKSBURGICA, new species.

Plate 97, figs. 1–16.

*Description.*—The zoarium is articulated, composed of large, long, cylindrical segments; the younger segments have only one basal pore, but the older ones have two of them. The zooecia are much elongated, distinct, swollen; the frontal is covered with large, polygonal pores; the peristomiale is not distinct from the frontal. The peristome is very salient, oblique, thin in the young zooecia, very thick in the old ones. The ascopore is large (0.02 mm.). The ovicelled zooecia have a larger external aperture.

| | | Old zooecia. | Young zooecia. |
|---|---|---|---|
| *Measurements.*— | Peristomice | =0.16 mm. | =0.12 mm. |
| | Peristome | =0.30 mm. | =0.18 mm. |
| Zooecia | $Lz$ | =1.40 mm. | =1.40 mm. |
| | $lz$ | =0.60–0.65 mm. | =0.50–0.60 mm. |

*Variations.*—In the recent species of this genus calcification is rather regular, and the upper segments of the zoarium are essentially identical with the lower ones. This is not the case with *Tubucellaria vicksburgica*, where the progress of calcification is not equal in either one or the other. This has resulted in very different external aspects, but it is easy to find good intermediate stages, for, fortunately, the species is not rare.

On the young zooecia the peristome is very salient (figs. 2, 3) or slightly salient (fig. 4); the pores are then disposed at the base of the small longitudinal canals. The peristome is thicker on the intermediate specimens (fig. 15), and on the segments of the base of the zoarium it is very large and hides all of the peristomiale (fig. 8).

The system of ramification is very remarkable. The zooecium bears in place of the usual peristomie an enormous, very prominent apophysis perforated by two (fig. 15) or four (fig. 8) very large pores. The base of the branched segments presents the same disposition of two (fig. 11) pores. We must therefore admit that the segments are thus united to each other by means of a corneous double joint; the apophysis with four pores bears perhaps two segments of ramification. At the end of the segments the branching takes place in the same manner, but without prominent processes (fig. 8). The zooecia which branch and articulate in this way are unprovided with an ascopore. We have attempted a restoration (fig. 1) of the base of the zoarium; the number of specimens did not permit us to complete it with young segments. The latter bear only a single pore at their base and are joined to the other segments only by a single chitinous joint, according to the general rule.

The tubules are not cylindrical; their diameter is augmented without cessation; consequently the frontal pores are smaller on the young segments (figs. 3, 4) than on the old segments (figs. 8, 15). The progress of this calcification deforms the zooecia and the peristomiale is separated from the frontal by a small furrow.

There are six longitudinal rows of zooecia to each segment.

The longitudinal section (fig. 13) unfortunately does not include an ovicell.

The tangential thin section (fig. 16) shows a tremocyst, of which the pores are separated by a complex and very characteristic network.

In the interior (fig. 13) we note a very thin olocyst, of which each small perforation engenders a funnel-shaped tubule. This same arrangement may be easily studied on the living specimens. This sort of tubule may not be ramified as in *Myriozoum*, since its successive widening offsets the increase of volume.

*Tubucellaria vicksburgica* is one of the most notable species of the ancient early Tertiary Gulf.

The great distribution of this species in the Vicksburgian occasions its name.

*Occurrence.*—Vicksburgian (Marianna limestone): West bank Conecuh River, Escambia County, Alabama (common); 1 mile north of Monroeville, Alabama (very common); Salt Mountain, 5 miles south of Jackson, Alabama (rare); Murder Creek, east of Castleberry, Alabama (rare).

Vicksburgian (Byram marl): Byram, Mississippi (rare); Woodward, Mississippi (very rare).

Vicksburgian (Red Bluff clay): Seven and one-half miles from Bladon Springs, Alabama (rare); near Claiborne, Monroe County, Alabama (rare); 2½ miles north of Millry, Washington County, Alabama (rare); Vicksburg, Mississippi (very rare in the lower beds); deep well, Escambia County, Alabama.

*Cotypes.*—Cat. No. 64314, U.S.N.M.

### TUBUCELLARIA NODIFERA, new species.

Plate 70, figs. 11–17.

*Description.*—The zoarium is articulated and formed of rather long cylindrical segments. The zooecia are very elongated, distinct, fusiform; their frontal is convex and ornamented with polygonal pores; the peristomiale is not separated from the frontal. The peristome is salient, thin, disposed obliquely on the segment. The ascopore is large and placed on the frontal; it opens into the zooecia. Certain verticells of zooecia present a very salient, extremely *nodose* frontal, which characterizes the species.

*Measurements.*—Peristome=0.10 mm.
Peristomice=0.20 mm.
Zooecia $Lz$=1.00–0.10 mm.
$lz$=0.30–0.35 mm.

*Affinities.*—The nodosities which ornament the segments of this species are quite original; they result from the considerable growth of the tubules over the ascopore (fig. 16). Probably on account of equilibrium there are always two series of nodose verticells to each segment (fig. 14); the three thick upper zooecia are placed in quincunx with the three thick lower zooecia. These verticells have not always exactly the same volume (fig. 12). We can hardly conceive what particular adaptation could correspond to this special arrangement.

No fossil or living species presents the peculiar character of this species and comparisons are therefore not necessary.

*Occurrence.*—Upper Jacksonian (Ocala limestone): Alachua, Florida (common).

*Cotypes.*—Cat. No. 64186, U.S.N.M.

### Subgenus TUBUCELLA Canu and Bassler, 1917.

1917. *Tubucella* CANU and BASSLER. Synopsis of American Early Tertiary Cheilostome Bryozoa, Bulletin 96, United States National Museum, p. 62.

The zoarium is free, bilamellar, firmly attached, rigid. The avicularia are very rare. The peristomiale is equal to the frontal.

*Genotype.*—*Tubucella* (*Eschara*) *mammillaris* Milne-Edwards, 1836.[1]

*Range.*—Lutetian-Jacksonian.

The articulation is not a function; it is a mode of adaptation on a mobile substratum. We are, therefore, not able to consider the nonarticulated species as forming a special genus. An artificial subgenus appears to us useful for classification.

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[1] 1908, Canu, Bryozoa of Tertiary formations of the environs of Paris, Annales de Paleontologie, vol. 3, p. 73, pl. 9, figs. 3–6.

The only known described species of this genus are *Tubucella mammillaris* Milne-Edwards, 1836, of the Lutetian-Sannoisian of Europe and *Tubucella papillosa* Reuss, 1847, of the Priabonian of the Vicentin. We have discovered two species in the American deposits.

### TUBUCELLA MONILIFERA Canu and Bassler, 1917.

Plate 70, figs. 18–25.

1917. *Tubucella monilifera* Canu and Bassler, Synopsis of American Early Tertiary Cheilostome Bryozoa, Bulletin 96, United States National Museum, p. 63, pl. 5, fig. 9.

*Description.*—The zoarium is free; the two lamellae are placed back to back and intimately joined; the fronds are broad, compressed, distorted, and branching. The zooecia are much elongated, fusiform, little distinct, surrounded by a *collar* of large pores; the frontal and the peristomiale are of equal length, separated by the ascopore and perforated with small hexagonal pores. The peristome is salient, thick, oblique. The avicularia are very rare, large, transverse, elliptical, usually with two denticles for a pivot.

*Measurements.*—Zooecia $\begin{cases} Lz = 0.90\text{–}1.00 \text{ mm.} \\ lz = 0.32 \text{ mm.} \end{cases}$

*Variations.*—The zooecia are very constant in their exterior aspect. The larger pores surround the peristomiale and are three times larger than the others.

Certain fronds bear some zooecia (fig. 20) closed not by the olocyst, but by the tremocyst, the tubules of which have encroached upon the peristome. The physiological function of these zooecia is unknown.

The avicularia are scattered, are very large, and form a very large frontal (fig. 21), the origin of which is one of the lateral pores of the peristomiale.

We have often noted before the faculty of the tremocystal buds to transform themselves into avicularia.

Ovicelled zooecia have been observed and are illustrated in figure 22, where, also, an avicularium with pivot may be noted.

In the interior (fig. 24) we have noted a very thin perforated olocyst surmounted by a tremocyst with tubules. The ascopore opens very far from the aperture and the peristomie. In comparing the extreme simplicity of this internal structure with the beauty and regularity of the exterior ornamentation, we must admire the splendor of the work of the buds of the endocyst, whose calcareous deposits so successfully modify the aspect of the zooecia.

*Affinities.*—This species differs from *Tubucella mammilaris* Milne-Edwards, 1836, in its nonprominent ascopore and the absence of large globular ovicells.

It differs from *Tubucella papillosa* Reuss, 1847, in the absence of the arched ovicelled zooecia and its much straighter fronds.

It differs from *Tubucella gibbosa* in the absence of large zoarial gibbosities around certain peristomies.

On account of the size of the fragments this is an easily recognized fossil.

*Occurrence.*—Middle Jacksonian: Wilmington, North Carolina (common); Eutaw Springs, South Carolina (very rare).

*Cotypes.*—Cat. No. 62605, U.S.N.M.

### TUBUCELLA GIBBOSA, new species.

Plate 71, figs. 1–9.

*Description.*—The zoarium is free, bilamellar, dichotomously branched; the fronds are wide and compressed. The zooecia are indistinct; the peristomiale is a little smaller than the frontal and they are separated from each other by a small ascopore; the pores of the frontal are a little smaller than those of the peristomiale. The peristomie is salient, little thickened; the peristomie is very long and arched. Around the peristomie of certain zooecia the tubules are much developed, forming on the zoarium very prominent *gibbosities*.

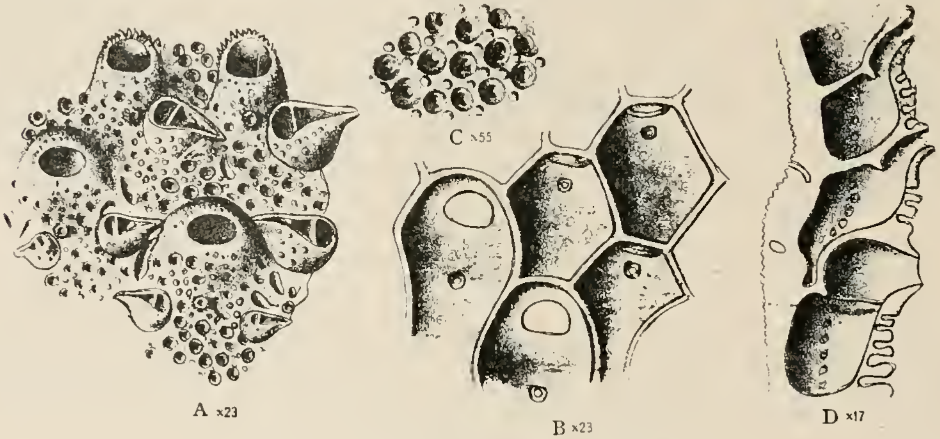

FIG. 161.—Genus *Tubiporella* Levinsen, 1909.

A–D. *Tubiporella magnirostris* MacGillivray, 1882. A. Group of zooecia showing two peristomial ovicells, × 23. B. View after removal of the basal surface. Two ovicells are seen and the three zooecia show a distinct vestibular arch. × 23. C. A part of the surface of a zooecium, × 55. D. A sagittal section through the zoarium. An ovicell is seen proximally and the two zooecia show a vestibular arch at the beginning of the peristomial tube, × 17. (A–D after Levinsen, 1909.)

*Measurements.*—Zooecia $\begin{cases}\text{Peristome}=0.20\text{ mm.}\\ Lz=0.85\text{ mm.}\end{cases}$

*Affinities.*—The gibbosities which characterize this species are quite original. The sections which we have prepared (figs. 8, 9) show that they result from the extraordinary development of the tubules around certain peristomies. The zooecia which bear them are without ovicells. In *Tubucellaria nodosa* it is, on the contrary, the frontal tubules which are much developed about the ascopore: this is a fundamental difference. We are also ignorant of the physiological purpose of the development of the peristomial tubules.

The length of the tubules is always very variable, as can be noted on the figured sections (figs. 6, 7).

We have been rather fortunate in reconstructing a part of the zoarium, the dimensions of which ought to attain about four or five centimeters in length.

It is very easy to distinguish this species from all known forms.

We have not had the chance to discover the ovicell in the eight sections which have been studied.

*Occurrence.*—Middle Jacksonian: Lenuds Ferry, South Carolina (common).

*Cotypes.*—Cat. No. 64187, U.S.N.M.

### **Genus TUBIPORELLA Levinsen, 1909.**

1909. *Tubiporella* LEVINSEN, Morphological and Systematic Studies on Cheilostomatous Bryozoa, p. 305.

A membraneous opercular valve. A vestibular arch, each zooecium with one or two avicularia at the height of the ascopore. The colony occurs as a free, foliaceous expansion with a single layer of zooecia (Levinsen).

*Genotype.*—*Tubiporella* (*Lepralia*) *magnirostris* MacGillivray, 1882.
*Range.*—Miocene—Recent.

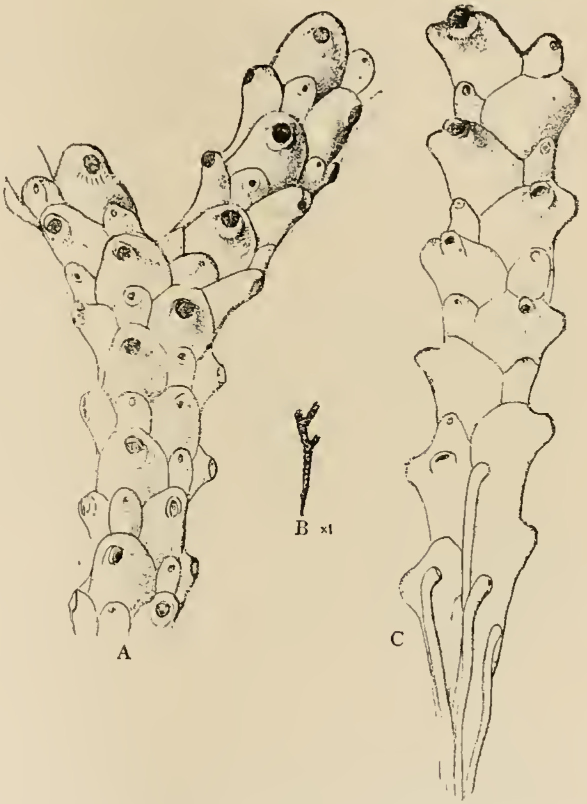

FIG. 162.—Genus *Siphonicytara* Busk, 1884.
A–C. *Siphonicytara serrulata* Busk, 1884. A. Frontal side of zooecium, enlarged. B. Zoarium, natural size. C. Dorsal side showing radical tubes. (A–C after Busk, 1884.)

### **Genus SIPHONICYTARA Busk, 1884.**

1884. *Siphonicytara* Busk, Report on the Polyzoa collected by H. M. S. *Challenger*, p. 101.

Busk, in 1884, placed in this family his new genus *Siphonicytara*, specimens of which have never been found since and for which reason it has not been possible to make supplementary studies. His original description and figures follow.

"Zoarium continuous, radicate, branched, branches alternate, subcylindrical quadriserial, subsecund. Zooecia completely immersed below, flattened in front. Peristome tubular, extended. A circular median pore below the middle of the front. A large circular orifice (avicularian?) near the top of most of the lateral zooecia behind."

*Genotype and only species.*—*Siphonicytara serrulata* Busk, 1884. Recent. East Indies.

## Family CATENICELLIDAE Busk, 1852.

### Genus CATENICELLA D'Orbigny, 1852.

**CATENICELLA SUBSEPTENTRIONALIS Canu and Bassler, 1917.**

Plate 96, fig. 11.

1917. *Catenicella subseptentrionalis* CANU and BASSLER, Synopsis of American Early Tertiary Cheilostome Bryozoa, Bulletin 96, United States National Museum, p. 63, pl. 5, fig. 5.

The Catenicellidae are bryozoa peculiar to the southern hemisphere. They abound in the recent seas off Australia, and their fossil forms are frequent in the same region. However, Waters [1] discovered in the Priabonian of the Vicentin two species having some affinities with this family; namely, *Catenicella septentrionalis* Waters, 1891, and *Catenicella continua* Waters, 1891. According to Waters [2] the latter species is a *Vittaticella* and the first belongs to a new genus.

The single and unique fragment found in America is very close to *Catenicella septentrionalis* Waters, 1891. It differs from it in its somewhat larger micrometric dimensions, more closely arranged frontal pores and in the presence of a small, oral avicularium.

*Occurrence.*—Vicksburgian: Salt Mountain, five miles south of Jackson, Alabama (very rare).

*Holotype.*—Cat. No. 62601, U.S.N.M.

## Family ADEONIDAE Jullien, 1903.

*Bibliography* (*Anatomical*).—1889. WATERS, Bryozoa from New South Wales, Annals Magazine Natural History, ser. 6, vol. 4, pl. 1, fig. 5.—1903. JULLIEN, Bryozoaires provenant des campagnes de *l'Hirondelle*, pl. 14, fig. 4.—1912. WATERS, A structure in Adeonella (Laminopora) contorta Michelin, with remarks on the Adeonidae, Annals Magazine Natural History, ser. 8, vol. 9, p. 490, pls. 10 and 11.—1913. WATERS, The Marine Fauna of Zanzibar, Proceedings of the Zoological Society of London, pl. 73, figs. 1–8.—1909. LEVINSEN, Morphological and Systematic Studies of the Cheilostomatous Bryozoa, p. 282, pl. 14, figs. 1–5; pl. 23, fig. 9.

The zooecia are provided with a compensatrix, but are devoid of spines and oral glands. The areolae are always closed and excavated out of the wall substance itself. The frontal is composed of an olocyst covered by a very thick pleurocyst. The operculum opens at the bottom of a peristomie. The female zooecia are of the kind termed gonoecia and are often larger than the others; they contain an ovicell sac, in which the embryo is developed. The septules are numerous, placed in linear rows, arranged to correspond to the areolae. The avicularia are frontal or interzooecial; the latter have no pivot. 13–16 tentacles.

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[1] North Italian Bryozoa, Quarterly Journal Geological Society, London, vol. 47, 1891, p. 5, pl. 1, figs. 1–8.

[2] Marine Fauna Zanzibar, Proceedings Zoological Society, London, 1913, p. 483.

*History.*—The history of this group has been given by Gregory[1] in some detail. Primarily the name of *Adeona* Lamouroux, 1816, was applied to species which had a fenestrated zoarium provided with radicular fibers. It was created simply for a form of zoarial growth and it should never have changed in meaning. In 1884 Busk created the family and characterized it by the trimorphic zooecia and the presence of an ascopore. In 1907 Canu discovered in the French Lutetian a group of species devoid of ascopores, and formed for them the family Meniscoporidae. In 1909 Levinsen confirmed the fact that *Bracebridgia* was indeed a member of the Adeonidae, whence Canu's family Meniscoporidae became superfluous. The family Adeonidae is now well established on ovarian characters and important anatomical features.

*Structure and terminology.*—It is always easy to recognize a species of the Adeonidae by rubbing away one face of the zoarium so as to reveal the areolar cavities of the walls (parietal areolae). This character is a general one and has no exception. In all the other families of the sub-order Ascophora, the areolar pores communicate directly with the interior itself of the zooecium, but in the Adeonidae the areolar cavities do so by means of the septules. These cavities serve for the passage and protection of the endocystal elements which must secrete and deposit the pleurocyst.

The gonoecia are often larger than the other zooecia; their aperture is different and their frontal pores are more numerous. They develop first a normal polypide, which soon disappears by histolysis and is replaced by a small polypide placed at the distal extremity and a large ovicell sac occupying the greater part of the gonoecium; here the embryo is developed. The form of the gonoecia is rather variable, as noted by Canu,[2] who has made a special study of this subject.

The great thickness of the pleurocyst causes the formation of a peristomie, at the bottom of which is the aperture (primary orifice of Hincks) closed by the operculum and of which the form is constant. The external orifice of this peristomie is the peristomice (secondary orifice of Hincks); its form is irregular and it is surrounded by a more or less salient peristome. The form of the aperture is often hidden, and in order to discover it, it is necessary to rub away the posterior face of the zoarium to examine the interior of the zooecia.

The hydrostatic system is quite variable. We have found all the variations noted in the other families of Ascophora. The genera, which are without frontal ascopores, have an operculum like *Schizoporella*, *Hippoporina*, etc., of which the anterior part serves to close or to open its compensatrix. The operculum of the genera provided with frontal ascopores is semilunar and water penetrates into the compensatrix by means of the ascopores. Finally, as in *Galeopsis*, the water passes first into the vestibule by a spiramen before penetrating into the compensatrix.

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[1] British Palaeogene Bryozoa, Transactions Zoological Society, London, vol. 13, 1893, p. 241.

[2] Bryozoa Environs Paris, Annales de Paleontologie, 1907, p. 49.

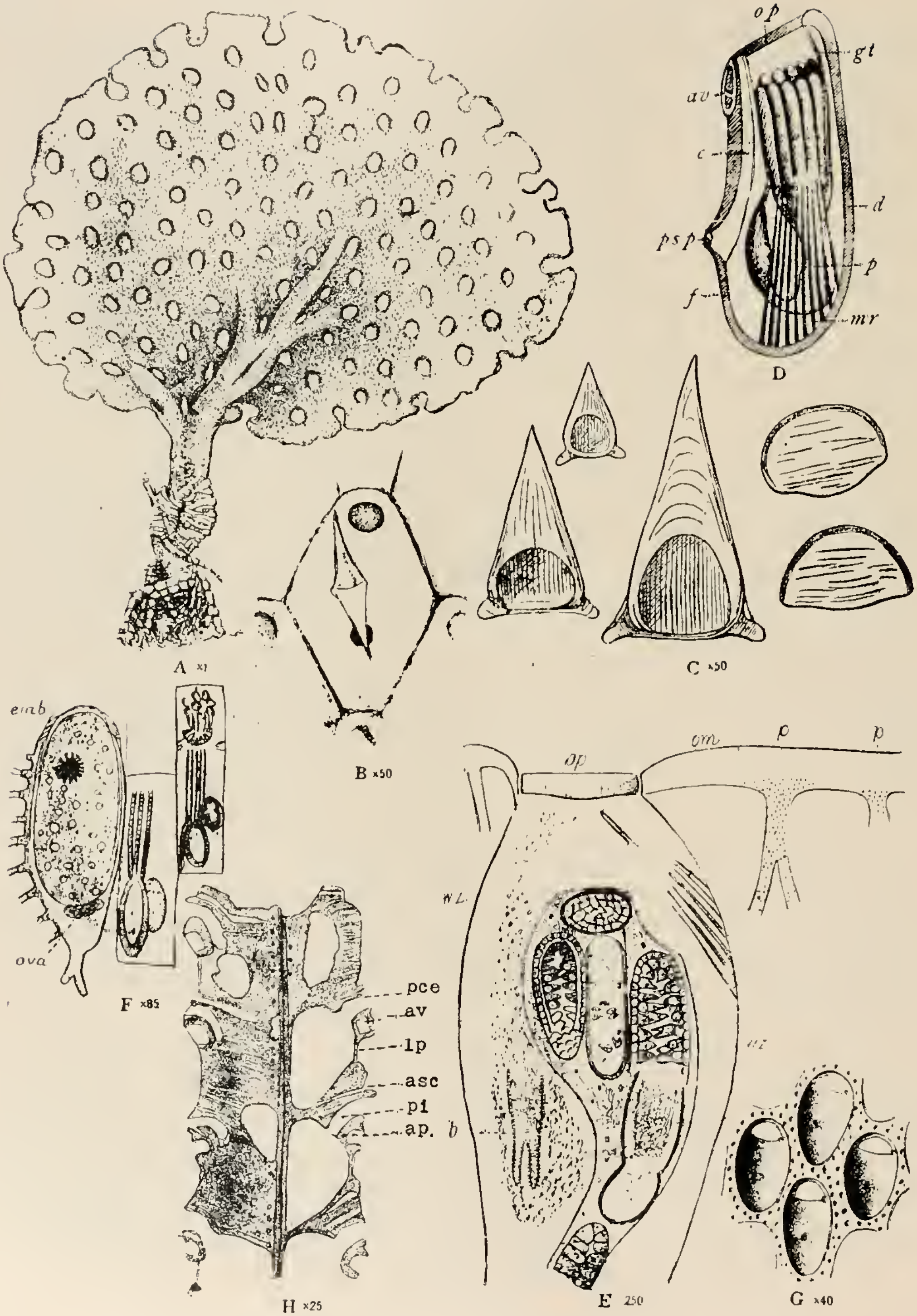
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FIG. 163.—Anatomical structure of the family Adeonidae Jullien, 1903.

FIG. 163.—Anatomical structure of the family Adeonidae Jullien, 1903.

A. *Adeona grisea* Lamouroux, 1816. Specimen natural size, with radicles and fenestrae. (After MacGillivray, 1880.)

B, C. *Adeona appendiculata* Busk, 1884. B. A zooecium with ascopore and avicularium, × 50. C. Operculum and mandibles, × 50. (B, C after Busk, 1884.)

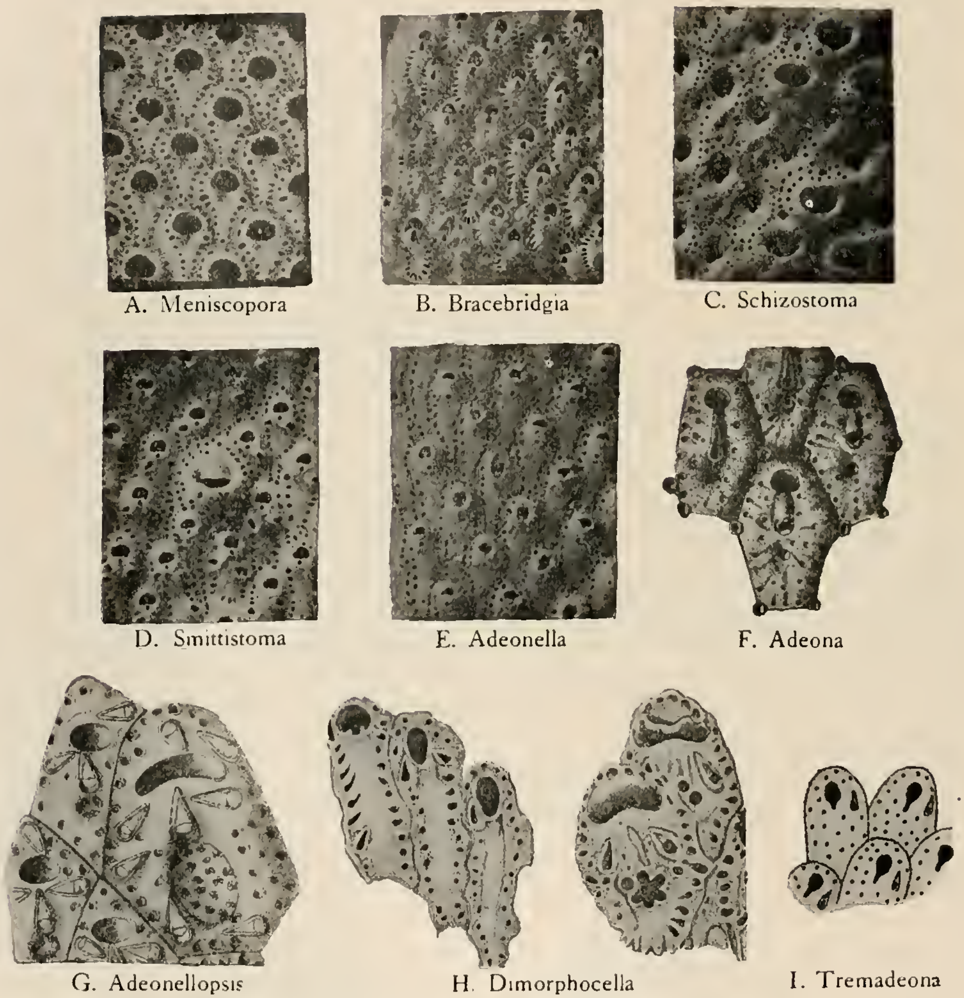
D. Structure of zooecium and polypide of *Adeona*. (After Jullien, 1888.)

*av*, avicularium; *e*, compensatrix; *d*, dorsal; *f*, frontal; *gt*, tentacular sheath; *mr*, retractor muscles of the polypide; *op*, operculum; *p*, polypide; *psp*, ascopore.

E, F. *Adeonella platalea* Busk, 1852. E. Section of a zooecium, × 250, showing a mass with several bodies and a part of a bud (*b*) by the side, but not inclosed in the mass; pore tubes (*p*) or tubulae full of dark cells; outer membrane or ectocyst (*om*) of the zoarium; operculum (*op*) walls of the zooecium (*w. z.*). This specimen is somewhat difficult to understand, as it has the appearance of being reversed. (After Waters, 1912.) F. Section, × 85, showing the ovicellular zooecium nearly filled by the embryo (*emb*), with an ovarium (*ova*) now proximal to the embryo. (After Waters, 1913.)

G, H. *Adeonellopsis coscinophora* Reuss, 1847. G. Interior, × 40, showing the ascopore, parietal areolae, and aperture. (After Levinsen, 1909.) H. Longitudinal section, × 25. (After Waters, 1889.)

*ap*, aperture; *asc*, ascopore; *av*, avicularium; *lp*, lamina perforata; *pec*, peristomice; *pi*, peristomie.



A. Meniscopora
B. Bracebridgia
C. Schizostoma
D. Smittistoma
E. Adeonella
F. Adeona
G. Adeonellopsis
H. Dimorphocella
I. Tremadeona

FIG. 164.—Genera of family Adeonidae Jullien, 1903.

A. *Meniscopora bigibbera* Gregory, 1893, × 55.

B. *Bracebridgia aculeata*, new species, × 20. Middle Jacksonian of Georgia.

C. *Schizostoma crassa* Canu, 1902, × 20. Lutetian of France.

D. *Smittistoma mortisaga* Stoliczka, × 20. Lutetian of France.

E. *Adeonella folliculata* Canu and Bassler, 1917, × 20. Middle Jacksonian of North Carolina.

F. *Adeona violacea* Johnston, × 40. Recent.

G. *Adeonellopsis foliacea* MacGillivray, 1895, × 40. Recent.

H. *Dimorphocella triton* MacGillivray, 1895. Miocene of Australia. (Ordinary zooecia without ascopore and gonoecia with ascopore.)

I. *Laminopora contorta* Michelin, 1842, × 25. Recent. (*Tremadeona* in error.)

The mode of calcification of the Adeonidae is more complicated. The primitive olocyst secreted by the endocyst is rather thin. It is covered by a pleurocyst secreted by the endocystal elements which pass through the parietal areolae and deposit over all of them more or less considerable quantities of lime. When the deposit is somewhat thick the parietal areolae are transformed into true tubules (pl. 15, fig. 14, and text fig. 163H). In transverse thin sections the pleurocystal elements superimposed and oriented in radial fibers (pl. 99, fig. 16) can be clearly seen.

The frontal avicularium is never visible in the interior; it early has no communication with the zooecia, and it is therefore nourished exteriorly by the endocyst proceeding from the areolae and covering the skeleton.

In tangential thin section these pleurocystal elements are very irregular and are grouped in still more irregular filaments (pl. 15, fig. 15). This is the characteristic of this secretion, which is very rare in the Anasca, but which develops frequently in the other Ascophora, and attains its maximum of development in the Adeonidae.

*Classification.*—The essential characters of classification of the Adeonidae have been given by Waters and Levinsen. There are three principal groups. The first comprises the species which are without frontal ascopores. This is the family Meniscoporidae Canu, 1907, composed of *Smittistoma*, *Meniscopora*, *Schizostoma*, *Calvetina*, and *Bracebridgia*. The second group is composed of the species which are provided with a spiramen and contains the single genus *Adeonella*. The third group contains the species which are provided with frontal ascopores and embraces the genus *Adeona* if the ascopore is simple and the genus *Adeonellopsis* if the ascopore is stellate.

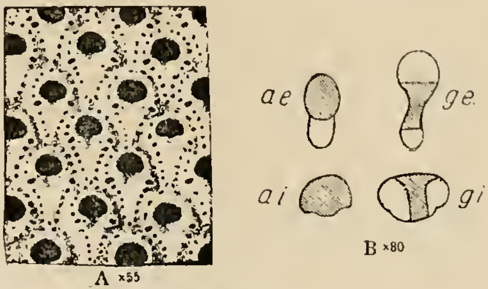


FIG. 165.—Genus *Meniscopora* Gregory, 1893.

A. *Meniscopora bigibbera* Gregory, 1893. Zooecia, × 55. (After Gregory, 1893.)

B. *Meniscopora simchi* Canu, 1907. Views of peristomice and apertura, × 80. (After Canu, 1907.) *ae*, peristomice of zooecium; *ai*, apertura of a zooecium; *ge*, peristomice of a gonoecium; *gi*, apertura of a gonoecium.

### Genus MENISCOPORA Gregory, 1893.

1893. *Meniscopora* GREGORY, British Palaeogene Bryozoa, Transactions Zoological Society, London, vol. 13, p. 250.

The zooecia are trimorphic. The normal axial zooecia have an external aperture straighter than that of the marginal zooecia; the aperture is formed of a semilunar anterior and of a very concave posterior part. The gonoecia are larger than the ordinary zooecia and their aperture is of different form. The peristomie is of slight depth. Interzooecial avicularia are rare. Certain lateral areolae are transformed into small frontal avicularia.

*Genotype.*—*Meniscopora bigibbera* Gregory, 1893.
*Range.*—Thanetian-Helvetian.

### MENISCOPORA SUBPLANA Ulrich, 1901.

Plate 2, figs. 4. 5.

1901. *Lepralia subplana* ULRICH, Maryland Geological Survey, Eocene. p. 219. pl. 59, figs. 17, 18.

*Original description.*—"Zoarium, as seen in three specimens, forming a hollow cylinder. composed of numerous layers, each 0.3 to 0.35 mm. in thickness. and varying in diameter according to the number of layers from 7 to 13 mm. Zooecia not very regularly arranged, sometimes subovate. at other times hexagonal or subquadrate, longer than wide, the length averaging about 0.45 mm. Upper surface nearly flat, the outline of the zooecia, in aged conditions especially, scarcely distinguishable and mainly by a double row of pores which, as shown by fractures, are the mouths of small tubes transversing the wall in a vertical direction. Front wall slightly convex, perforated, the pores usually smaller than those outlining the zooecia, distinctly visible on the inner surface. sometimes wanting over a varying space just behind the aperture. The latter is rounded in front. nearly straight behind, with the angles rounded. generally semielliptical. the width and length averaging, respectively, 0.15 and 0.13 mm. Small round or oval avicularia generally present. Their position is variable, though usually close to the rim of the aperture. While an occasional zooecium may occur, having no avicularia, as many or more will be found having one on each side of the aperture. Ooecia unknown.

Fractures dividing the zooecia vertically (fig. 4) show that the walls (side and front) are traversed by minute, wavy, vertical tubuli, and that the zooecial cavities are connected by two series of pores, the larger set near the bottom and a row of smaller pores above the midheight. The openings of the larger set are often irregularly distributed over the concave floors of the zooecia."

Ulrich's description is quite exact. The zoarium is multilamellar and incrusts algae; the lower face, in contact with the substratum is smooth or ornamented with numerous small hydrostatic tuberosities.

In the interior, the areolar cavities are quite visible.

The gonoecia are identical in form with the other zooecia, but they are somewhat larger.

*Occurrence.*—Lowest Eocene (Bryozoan bed at base of Aquia formation): Upper Marlboro, Maryland (not uncommon).

### MENISCOPORA ELLIPTICA, new species.

Plate 97, figs. 17–21.

*Description.*—The zoarium is an *Eschara* form composed of two lamellae placed back to back and easily separable. The zooecia are little distinct, elongated, straight: the frontal somewhat convex bears some pores which are little different from the lateral areolae. The peristomice is irregular, pyriform, the narrowest part below; the peristome is thick and complete; the peristomie is shallow, but it hides the real form of the aperture which (seen from the interior) is elongated and elliptical. On the line of the areolae, in the vicinity of the peristomice, there is a small, simple, *elliptical* avicularium somewhat pointed.

*Measurements.*—Aperture (interior) $\begin{cases} ha=0.10 \text{ mm.} \\ la=0.07 \text{ mm.} \end{cases}$ Zooecia $\begin{cases} Lz=0.55\text{–}0.65 \text{ mm.} \\ lz=0.25 \text{ mm.} \end{cases}$

*Affinities.*—The frontal pores and the avicularia are quite variable.

This species is very close to *Meniscopora* (*Eschara*) *semitubulosa* Reuss, 1869, of the Priabonian of the Vicentin. Unfortunately the latter has not yet been found again and no direct comparison is therefore possible.

*Occurrence.*—Vicksburgian (Byram marl): One-fourth mile west of Woodward, Wayne County, Mississippi (common).

*Cotypes.*—Cat. No. 64515, U.S.N.M.

### Genus BRACEBRIDGIA MacGillivray, 1886.

1886. *Bracebridgia* MacGillivray, Descriptions of new or little known polyzoa, part 9, Transactions Royal Society of Victoria, p. 8.
(Syn. *Porostoma* Canu, 1907.)

"Zoarium bilaminate, erect. Apertura subcircular, straighter below, with an internal denticle; peristome thickened, smooth or with a small apiculate mucro; frequently in the fossils, but rarely in recent specimens, a triangular avicularium immediately below the lower lip; lateral avicularia on the free edges of the zoarium" (MacGillivray). The gonoecia are larger than the usual zooecia. The frontal is partially or totally covered over by a pleurocyst which is more or less confluent with the subjacent olocyst.

*Genotype.*—*Bracebridgia* (*Porella*) *emendata* Waters, 1881.

*Range.*—Jacksonian—Recent.

The genus *Porostoma* Canu, 1907, differs from *Bracebridgia* only in the place of the oral avicularium, which is placed entirely within the peristomie. Its function does not appear different, so it will be necessary to unite the two genera.

The known species of *Bracebridgia* are as follows:

*Bracebridgia* (*Porella*) *emendata* Waters, 1881, Miocene and Australian waters.

*Bracebridgia* (*Porina*) *subsulcata* Smitt, 1872. Recent, Florida.

*Bracebridgia* (*Eschara*) *polymorpha* Reuss, 1864. Tongrian.

*Bracebridgia* (*Eschara*) *ignobilis* Reuss, 1866. Middle Tongrian (=Rupelian).

*Bracebridgia* (*Porostoma*) *polymorphum* Canu, 1907, not Reuss, 1869. (=*B. dentiferum*, name new) Ypresian.

*Bracebridgia incisum* Canu, 1907. Ypresian.

*Bracebridgia* (*Porostoma*) *clavatum* Gregory. Lutetian.

*Bracebridgia* (*Meniscopora*) *subcrenulata* Canu, 1907. Ypresian-Lutetian, Bartonian.

*Bracebridgia* (*Porina*) *subsulcata* Smitt, 1872, has been dredged at depths from 10 to 48 fathoms. Osburn found it again off the Tortugas from 16 to 19 meters. He was kind enough to send us some specimens. The examination of their interior has proved to us that the species has no ascopore nor spiramen.

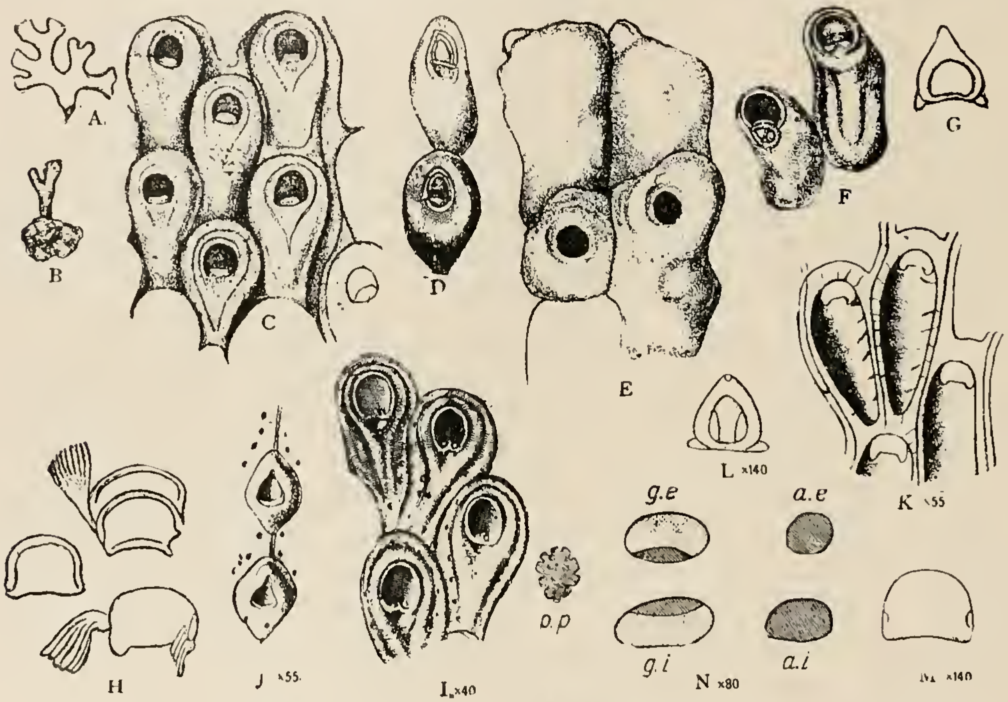


Fig. 166.—Genus *Bracebridgia* MacGillivray, 1886.

A–M. *Bracebridgia pyriformis* Busk, 1884. A. Specimen, natural size. B. Young specimen growing from an incrusting base; natural size. C. Portion toward the periphery, showing normal zooecia. D. Two avicularian cells from the margin of a lobe. E. Older zooecia toward the base of the specimen, two completely closed. F. Two zooecia from incrusting part, showing apiculate process and oral avicularium. G. Mandible of avicularium. H. Opercula from edge of a lobe. (A–H after MacGillivray, 1888.) I. Zooecia with parietal areolae. × 40. J. A portion of the margin of a zoarium with two avicularia, × 55. K. Four zooecia from the basal aspect after removal of the basal surface, × 55. L. An avicularian mandible, × 140. M. Operculum, × 140. (I–M after Levensen, 1909.)

N. *Bracebridgia* (*Poricella*) *elongata* Canu, 1907. Outlines, × 80. (After Canu, 1907.)

*ae*, peristome of a zooecium; *ai*, aperture of a zooecium; *ge*, peristome of a gonoecium; *gi*, aperture of a gonoecium; *pp*, frontal micropore seen from the interior.

### BRACEBRIDGIA ACULEATA, new species.

Plate 71, figs. 10–12.

*Description.*—The zoarium is free, bilaminar, composed of two lamellae placed back to back and separable. The zooecia are elongated, fusiform, distinct, separated by a furrow and surrounded by an especial line of areolae; the frontal is formed of thin, prominent interareolar costules, and of a false area due to incomplete pleurocystal calcification. The peristomie is of little depth; the peristome is thin, prominent, developed distally only; the aperture (as seen from the interior) is semilunar with an almost straight proximal border. The avicularium is median, simple, triangular; its point projecting, like a *spur.*

*Measurements.*—Peristomice $\begin{cases} hp = 0.10 \text{ mm.}^1 \\ lp = 0.10 \text{ mm.} \end{cases}$ Zooecia $\begin{cases} Lz = 0.50\text{–}0.60 \text{ mm.} \\ lz = 0.25\text{–}0.30 \text{ mm.} \end{cases}$

*Observation.*—Photography does not give exactly the aspect of this species; it does not show sufficiently the very great projection of the avicularium above the plane of the figure.

*Bracebridgia aculeata* differs from the other known species by its straight and median avicularium, which is never oblique, or sublateral.

In the interior the avicularium is invisible, and it is therefore of exterior or pleurocystal origin.

*Occurrence.*—Middle Jacksonian: Three and one-fourth miles south of Perry, Georgia (common).

*Cotypes.*—Cat. No. 64188, U.S.N.M.

### BRACEBRIDGIA POLYMORPHA Reuss, 1864, var. COSTULATA, new variety.

Plate 71, figs. 13–23.

1864. *Eschara polymorpha* Reuss, Fauna deutschen Oberoligocan, Sitzungberichte der k. Akademie der Wissenschaften, Wien, vol. 50, p. 651, pl. 12, fig. 6.

1868. *Eschara polymorpha* Reuss, Bryozoa deutschen Septarienthones. Sitzungberichte der k. Akademie der Wissenschaften, Wien, vol. 52, p. 61, pl. 8, figs. 8–10.

1867. *Eschara polymorpha* Reuss, Fauna Steinsalzablagerung, Sitzungberichte der k. Akademie der Wissenschaften, Wien, vol. 55, p. 144.

*Measurements.*—Aperture $\begin{cases} ha = 0.08 \text{ mm.} \\ la = 0.10 \text{ mm.} \end{cases}$

*Variations.*—The areolae form a line of small pores around each zooecium (figs. 15, 20). Between them short costules often develop (figs. 17, 20).

The pleurocyst is not very regular; it forms a prominent collar around each zooecium, in the form of an interrogation point. Below the avicularium there is an irregular, triangular area, the depth and size of which depends upon the pleurocystal activity, which is always very irregular.

The avicularium, when it is well preserved, deforms the external aperture (figs. 15, 18, 21); it is oblique (figs. 15, 18) or transversal (fig. 17); the two positions may be observed on the same zoarial fragment (fig. 21).

The gonoecia (figs. 14, 22) are larger than the usual zooecia.

All these characters are lessened by fossilization (fig. 23) and the zooecia appear very polymorphic.

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[1] In the Adeonidae we give the dimensions of the peristomice or external aperture when this is somewhat constant, in preference to the dimensions of the apertura which can be measured only in the interior of the zooecia.

In the interior the aperture is semilunar and transverse with a slightly concave proximal border.

In examining the figures of Reuss we can note only a few differences of little importance: the interareolar costules appear less salient and the avicularium there appears smaller and more removed from the external aperture. At the most, our specimens form a variety.

*Occurrence.*—Middle Jacksonian: Eighteen miles west of Wrightsville, Johnson County, Georgia (rare): Rich Hill, 5¼ miles southeast of Knoxville, Georgia (rare); 12 miles southeast of Marshallville, Georgia (rare); one-half mile southeast of Georgia Kaolin Company Mine, Twiggs County, Georgia (rare).

*Geological distribution.*—In Europe the species occurs in the Latdorfian of Latdorf (Reuss), Rupelian of Germany (Reuss), Chattian of Germany (Reuss). These three are the substages of the Tongrian. Finally, Reuss cited it from the Tortonian of Wieliezka in Pologne, but he did not give a figure.

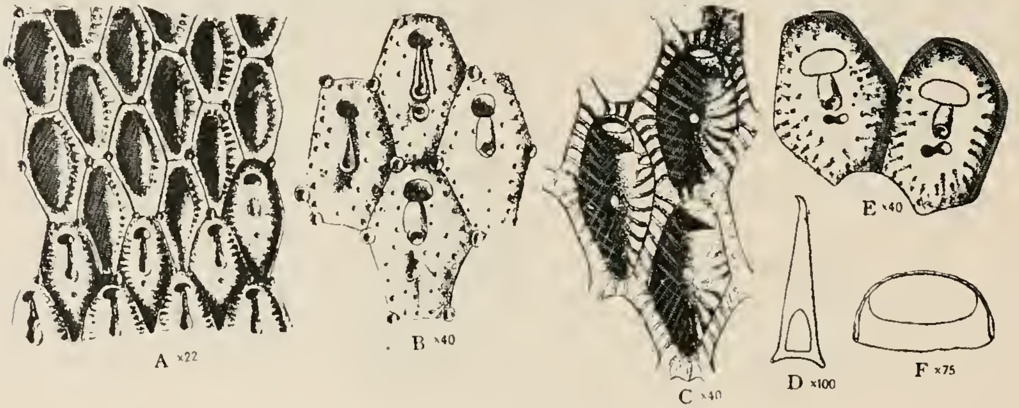

Fig. 167.—Genus *Adeona* Lamouroux, 1816.

A–F. *Adeona violacea* Johnston, 1849. A. Portion of zoarium, × 22, showing numerous marginal zooecia with frontal wall still uncalcified. B. Four zooecia, × 40, two of which have the avicularium replaced by an elongated cavity which opens by means of a round pore. C. Three zooecia, × 40, viewed from the basal side after removal of the basal surface. The primary aperture and the proximal margin of the secondary are visible. D. Avicularian mandible, × 100. E. Two gonoecia, × 40, furnished with a cavity instead of an avicularium, like the zooecia in fig. B. F. Operculum, × 75. The transverse oval part, somewhat more chitinized, corresponds with the secondary aperture. (A–F after Levinsen, 1909.)

*Cotypes.*—Cat. No. 64190, U.S.N.M.

### Genus ADEONA (Lamouroux, 1816) Levinsen, 1909.

1909. *Adeona* Levinsen, Morphological and Systematic Studies on Cheilostomatous Bryozoa, p. 283.

The frontal is perforated by an ascopore opening into the compensatrix. The operculum is semilunar. The gonoecia are distinct and larger than the ordinary zooecia.

*Genotype.*—*Adeona* (*Cellepora*) *heckeli* Reuss, 1847.

### Genus ADEONELLA (Busk, 1884) Waters, 1888.

1884. *Adeonella* Busk, Report on the Polyzoa collected by H. M. S. *Challenger*, 1873–76, vol. 10, pt. 30, p. 183.

"Zoarium erect, very variously branched or lobate, attached by a contracted base or pedicle, often containing radical fibers and affixed usually on a more or less flexible support (Busk)." "The zooecia without such median ascopores; the proximal part of the secondary aperture, which appears sooner or later, is transformed by a coalescence of two calcareous processes into a pore, which leads into the space between the primary and secondary aperture." (Levinsen, Waters.)

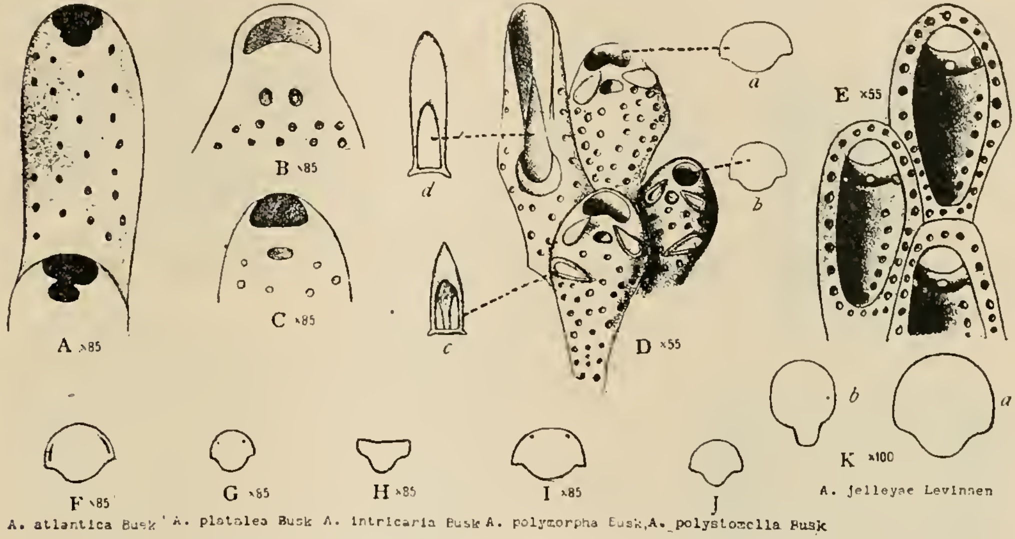

Fig. 168.—Genus *Adeonella* (Busk, 1884) Waters, 1888.

A–C. *Adeonella polymorpha* Busk, 1884. A. Young cells, the lower one showing the commencement of the bridge, × 85. B. Ovicelligerous cell with double pore, × 85. C. Cell with bridge forming a peristomial pore or spiramen, × 85. (A–C after Waters, 1888.)

D–E. *Adeonella serrata* Levinsen, 1909. D. Two gonozooecia, an independent (interzooecial) avicularium and an ordinary zooecium, × 55.

*a*, operculum of a gonozooecium, × 55; *b*, operculum of a zooecium, × 85; *c*, the mandible of a dependent (frontal) avicularium, × 85; *d*, the mandible of an independent (interzooecial) avicularium, × 55.

E. The zooecia, from the basal aspect, after the removal of the basal surface, showing the interior, × 55. (D–E after Levinsen, 1909.)

F–J. Opercula, × 85. (After Waters.) F. *Adeonella atlantica* Busk, 1884. G. *A. platalea* Busk, 1852. H. *A. intricaria* Busk, 1884. I. *A. polymorpha* Busk, 1884. J. *A. polystomella* Reuss, 1847.

K. Operculum of *Adeonella jelleyae* Levinsen, 1909. *a*, gonozooecium; *b*, ordinary zooecium. (After Levinsen, 1909.)

The peristomie is perforated by a spiramen. The aperture bears a concave lower lip, which is the opening of the compensatrix. The operculum is at the bottom of the peristomie and below the spiramen. 13–16 tentacles.

*Genotypes.*—*Adeonella polymorpha* Busk, 1884, and *Adeonella* (*Eschara*) *polystomella* Reuss, 1847.

*Range.*—Jacksonian—Recent.

### ADEONELLA FOLLICULATA Canu and Bassler, 1917.

Plate 72, figs. 1–8.

1917. *Adeonella folliculata* Canu and Bassler, Synopsis of American Early Tertiary Cheilostome Bryozoa, Bulletin 96. United States National Museum, p. 66, pl. 6, fig. 3.

*Description.*—The zoarium bilamellar with two lamellae, back to back, and separable. The fronds are lobed, *very thin*, and fragile. The zooecia are very long, distinct, separated by a furrow, little convex, bordered with numerous parietal areolae (10–12 pairs). The peristomie is short, somewhat projecting exteriorly and is perforated by a spiramen; the peristomice is semilunar with a convex lower lip; the aperture (interior) presents a proximal concave border. The gonoecia are (0.30 mm.) larger than the other zooecia; their external aperture is greater ($la=0.10$ mm.) and the spiramen is more removed from the aperture. There is a very small, simple avicularium on the peristome.

*Measurements.*—Lateral zooecia $\left\{\begin{array}{l} Lz=0.65\text{–}0.75\text{ mm.} \\ lz=0.20\text{–}0.25\text{ mm.} \end{array}\right.$ Axial zooecia $\left\{\begin{array}{l} Lz=0.50\text{ mm.} \\ lz=0.20\text{ mm.} \end{array}\right.$

Gonoecia $\left\{\begin{array}{l} Lz=0.50\text{ mm.} \\ lz=0.30\text{ mm.} \end{array}\right.$ Peristomice of zooecia $\left\{\begin{array}{l} hp=0.04\text{ mm.} \\ lp=0.07\text{ mm.} \end{array}\right.$

Peristomice of gonoecia $\left\{\begin{array}{l} hp=0.04\text{ mm.} \\ lp=0.10\text{ mm.} \end{array}\right.$

*Variations.*—The zooecial walls are so thin and fragile that it is difficult to obtain a good interior presenting all the characters of the species, and it is necessary to study this feature by successive rubbing away of the substance.

The axial zooecia are shorter than the lateral ones (figs. 3, 6), nevertheless there are fronds composed uniquely of long zooecia alone (fig. 4).

Often one of the parietal areolae is transformed into a small, simple avicularium, slightly pointed (fig. 2) and of inconstant position. Just as the zooecial areolae may be transformed into avicularia, the parietal pores resulting from a growth of the ectocyst are susceptible to continuation of evolution, according to the needs of the zoarium.

The small peristomial avicularium is round; its place is very variable, but always on the distal border.

The gonoecia are somewhat larger (0.30 mm.) and their external aperture also larger (0.10 mm.); the spiramen is placed farther from the external aperture and perhaps it opened exactly at the level of the operculum, instead of being above it (fig. 6).

Figure 5 represents a very common alteration by fossilization.

The fronds have the thinness of a leaf and are very fragile.

*Occurrence.*—Middle Jacksonian (Castle Hayne limestone): Wilmington, North Carolina (common).

*Cotypes.*—Cat. No. 62608, U.S.N.M.

### Genus ADEONELLOPSIS MacGillivray, 1886.

1886. *Adeonellopsis* MacGillivray, Description of New Polyzoa, pt. 9, Transactions Royal Society Victoria, p. 7.

"The zooecia provided in the central line with one or several ascopores" (Levinsen). The ascopores are grouped at the base of a cribriform area. Interzooecial avicularia and gonoecia are present. 13–16 tentacles.

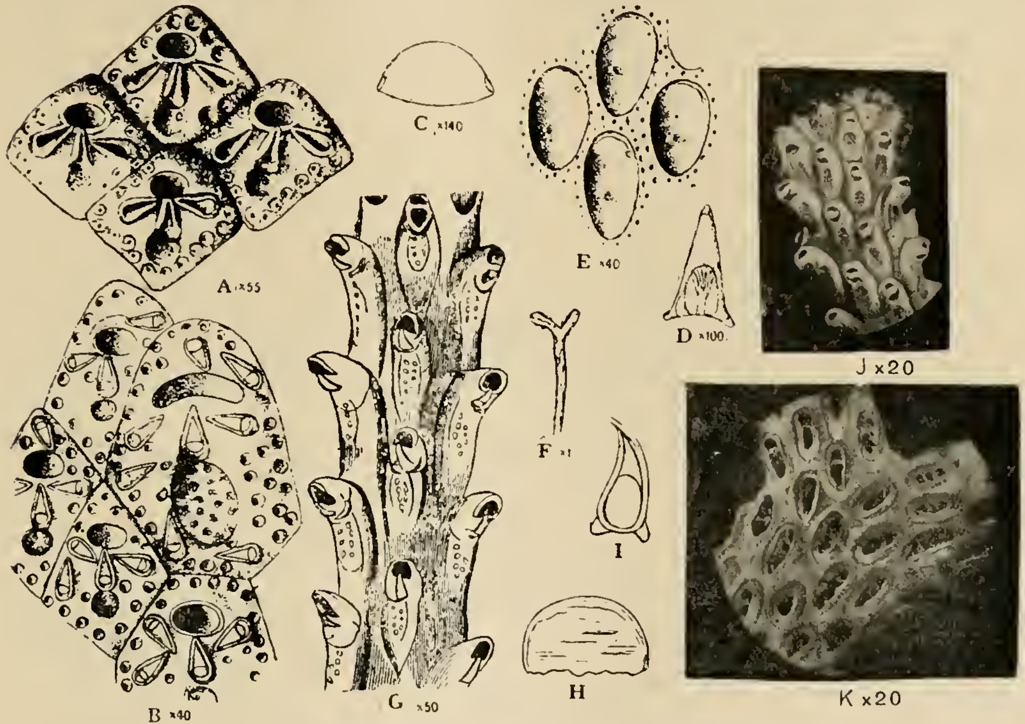

Fig. 169.—Genus *Adeonellopsis* MacGillivray, 1886.

A–E. *Adeonellopsis foliacea* MacGillivray, 1886. A. Four zooecia, × 55. B. Group of zooecia, including a gonozooecium, × 40. C. Operculum, × 140. D. Avicularian mandible, × 100. E. Interior of zooecia as seen from basal surface, × 40, showing ascopore, apertura, and parietal areolae. (A–E after Levinsen, 1909.)

F–K. *Adeonellopsis* (*Cribriecella*) *distoma* Busk, 1858. F, G. Fragment of zoarium, natural size and × 50. H. Operculum. I. Mandible. (F–I after Busk, 1884.) J. Young zooecia, × 20. K. Old zooecia, × 20. (J, K after Mme. Guérin Ganivet, 1911.)

*Genotype.—Adeonellopsis foliacea* MacGillivray, 1886.

*Range.*—Wilcoxian—Recent.

We are entirely ignorant of the physiological use of the stellate pores, and also of the true mechanism of the hydrostatic system in the majority of the species.

The gonoecia are not always apparent; certain species are deprived of them; on others they are distinct but little different from the other zooecia.

*Historical.*—Incompletely defined in 1886 by MacGillivray, this genus has for a long time remained unrecognized. In 1900 Maplestone created a genus *Ovaticella* based on a badly preserved example provided with a cribriform area. In 1902 Levinsen formed a genus *Lobopora* for the species having *Eschara coscinophora* Reuss, 1847, for type. In 1904 Canu, not yet having learned of Levinsen's work, formed the genus *Cribricella* with the same genotype. He added a genus *Poricella* for a similar species, but without median avicularium. In 1909 Levinsen abandoned his genus *Lobopora* and classed in the genus *Adeonellopsis* MacGillivray, 1886, all the species provided with stellate ascopores. We adopt his classification because all the preceding genera have no different functions and therefore can not be accepted.

However, *Cribricella* and *Poricella* may be admitted as artificial subgenera in order to facilitate the classification.

The first subgenus, the group of *A. distoma-coscinophora*, ought to be the subject of special research, for it is much involved.

Under the name *Eschara coscinophora* Reuss, 1847, authors have united several different species.

First. *Cribricella* (*Eschara*) *distoma* Busk, 1878. This species is found living in the Atlantic from Madeira to the coasts of Brittany, where Madame Guerin-Ganivet recently found it.[1]

Second. *Cribricella* (*Eschara*) *coscinophora* Reuss, 1847, refigured by Manzoni in 1877. This is a Miocene fossil adorned with a small avicularium, small cribriform area, and very small parietal areolae.

Third. *Cribricella* (*Eschara*) *coscinophora* Reuss, 1864, 1866. This is an Oligocene species which Canu believed he had rediscovered in the Parisian Lutetian and to which he gave the new name of *Cribricella punctata*.

Fourth. *Cribricella* (*Eschara*) *coscinophora* Stoliczka, 1862. According to the excellent figure of the author, this is not Reuss's species, but is the *Cribricella* (*Adeonellopsis*) *wetherelli* Gregory, 1892, and probably also *Cribricella* (*Lobopora*) *coscinophora* Canu, 1907. However, this latter is provided with an adventitious avicularium on the old zooecia—a peculiarity not mentioned by Gregory or Stoliczka.

The differences between these various species are rather small; in effect they depend principally upon the micrometric dimensions. However, they are of real value upon serious analysis. As always, the German Oligocene species are the most problematic because for a long time we have been unable to obtain any specimens, either by purchase or exchange. It may be possible that the Oligocene species are identical with the Miocene, as Reuss himself believed, but this is not clearly apparent from the published figures.

The known species of this genus, in addition to the genotype, are:

*Adeonellopsis* (*Poricella*) *maçonnica* Canu, 1904. Upper Eocene of Tunis.
*Adeonellopsis* (*Poricella*) *elongata* Canu, 1907. Lutetian of Paris.
*Adeonellopsis obliqua* MacGillivray, 1895. Miocene of Australia.

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[1] Contributions à l'étude des Bryozoaires des cotes armoricaines, I. Bryozoâires provenant du Haut Fond de la Chapelle et recueilli en 1900 par l'expedition de la *Vienne*, Travaux du Laboratoire de Zoologie de Concarneau, vol. 3, 1911, p. 9, pl. 2, figs. 1, 2.

*Adeonellopsis distoma* Busk, 1858. Atlantic.
*Adeonellopsis* (*Eschara*) *coscinophora* Reuss, 1847. Oligocene of Germany.
*Adeonellopsis wetherelli* Gregory, 1892.

### ADEONELLOPSIS POROSA, new species.

Plate 8, fig. 13.

The specimen figured is the only one which has been found. It incrusts a shell. It is characterized by its large cribriform area, perforated by a dozen pores. It is possibly the base of a bilamellar zoarium.

*Occurrence.*—Wilcoxian (Bashi formation): Woods Bluff, Alabama (very rare).

*Holotype.*—Cat. No. 63813, U.S.N.M.

### ADEONELLOPSIS MAGNIPOROSA, new species.

Plate 8, figs. 14–20.

*Description.*—The zoarium is bilamellar; the fronds are wide and lobed. The zooecia are distinct, elongated, elliptical, much narrowed toward the back, separated by a deep furrow. The peristomice is transverse and semielliptic. The cribriform area is deep and perforated by *large* stellate pores. The median avicularium is triangular or orbicular, without pivot or denticle.

*Measurements.*—Zooecia (exterior) $\begin{cases} Lz=0.45\text{–}0.55\text{ mm.} \\ lz=0.25\text{–}0.30\text{ mm.} \end{cases}$ Zooecia (interior) $\begin{cases} Lz=0.50\text{ mm.} \\ lz=0.20\text{ mm.} \end{cases}$

Total area: $L=0.25$ mm.
Width of apertura$=0.09$ mm.

*Variations.*—The normal, adult zooecia have a transverse, semilunar, external apertura below which is a rather large, elliptical and oblique avicularium. The cribriform area is deep and contains from five to seven stellate pores (figs. 16, 20).

On old zooecia there is produced a strong pleurocystal incrustation in consequence of which the avicularium and the cribriform area become buried. Then the apertura, the avicularium, and the area are only visible in a single total area; the avicularium becomes triangular and pointed (fig. 15). Sometimes on the old zooecia there is an adventitious, round avicularium (?) below the total area (fig. 17).

In spite of the considerable variations of the exterior, the internal aspect (fig. 18) is, on the contrary, very constant, and in it are revealed the true characters of the species.

*Affinities.*—The new species differs from *Adeonellopsis wetherelli* Gregory, 1892, which it much resembles in the large size of the pores of the cribriform area. As this character is very constant we are obliged to give it specific importance.

This is also the American species which has the largest ascopores.

*Occurrence.*—Wilcoxian (Bashi formation): Woods Bluff, Alabama (common).

*Cotypes.*—Cat. No. 63830, U.S.N.M.

### ADEONELLOPSIS QUISENBERRYAE, new species.

Plate 15, figs. 20–26.

*Description.*—The zoarium is free, bilamellar, formed of widened fronds branching dichotomously; the two lamellae are placed back to back and are separable. The zooecia are elongated, distinct, separated by a furrow, surrounded by an especial line of numerous parietal areolae. The total area contains the aperture, the avicularium, and the cribriform area; the apertura in the interior is semilunar and transverse; the avicularium is very large, triangular, pointed and placed obliquely, its point touching one of the lateral walls; the cribriform area, little visible exteriorly, bears from five to seven small stellate pores on the interior. A salient. elliptical, adventitious avicularium is located at the base of each zooecium.

*Measurements.*—Zooecia $\begin{cases} Lz = 0.52\text{–}0.56 \text{ mm.} \\ lz = 0.30\text{–}0.36 \text{ mm.} \\ \text{and } 0.20 \text{ mm. (in the interior)} \end{cases}$

Length of the total area=0.16–0.30 mm.

Length of the avicularium=0.20 mm.

*Variations.*—On the young zooecia the cribriform area is small, exterior and externally entirely uniporous (fig. 21). The old specimens have a total area; the avicularium and the aperture are surrounded by a thick pleurocystal covering (figs. 22, 23, 25). This latter is so active on the undulating lamellae that the exterior zooecial measurements are larger than the interior measurements.

The zooecial walls are very thick; they are striated and show clearly the deposit of the pleurocyst, which is formed by the addition of successive layers on the exterior (fig. 24).

The basal zooecia (fig. 23) are covered with a calcareous deposit and lose their polypide. The parietal areolae and the avicularium alone persist.

*Affinities.*—This species is characterized by its avicularium, which is so oblique that its point touches one of the parietal walls of the total area. In *Adeonellopsis magniporosa* and *Adeonellopsis coscinophora* Reuss, 1847, the avicularium is straighter and in the total area never touches the walls.

It accompanies *Adeonellopsis transversa* in the same localities and in which the avicularium is also very oblique; it differs from it in its larger dimensions and in its cribriform area uniporous exteriorly and multiporous interiorly.

We dedicate this species to Adelaide C. Quisenberry in appreciation of the interest she has taken in this work and of her help in its preparation.

*Occurrence.*—Claibornian (Gosport sand): One mile southwest of Rockville, Clarke County, Alabama (rare); Gopher Hill, Tombigbee River, Alabama (rare).

Lower Jacksonian (Moodys marl): Jackson, Mississippi (rare).

*Cotypes.*—Cat. Nos. 63856, 63857, U.S.N.M.

### ADEONELLOPSIS TRANSVERSA, new species.

Plate 15, figs. 11–19.

*Description.*—The zoarium is free and bilamellar, the two lamellae being separable. The ordinary zooecia are elongated, little distinct, separated by a furrow.

elliptical in the interior, and surrounded by a score of areolae. The peristome is complete, somewhat projecting and rather thick. The peristomice is oval and elongated; the peristomie is shallow; it contains proximally a small pointed triangular avicularium almost *transverse*, and distally the aperture, which in the interior is semilunar with a slight convex proximal border. The stellate ascopore is placed on the median part of the zooecia close to the peristome. One of the areolae is transformed into a round, rather large, irregularly placed avicularium, giving to the zooecia a strange and undefinable aspect. The gonoecia are larger than the ordinary zooecia and bear three ascopores arranged in a triangle and placed in a cavity of the frontal.

*Measurements.*—Apertura (interior) $\begin{cases} ha=0.07 \text{ mm.} \\ la=0.08 \text{ mm.} \end{cases}$ Zooecia $\begin{cases} Lz=0.40\text{–}0.44 \text{ mm.} \\ lz=0.16\text{–}0.20 \text{ mm.} \end{cases}$

Height of peristomie=0.14–0.16 mm.

Gonoecia $\begin{cases} Lzg=0.40\text{–}0.50 \text{ mm.} \\ lzg=0.30 \text{ mm.} \end{cases}$

*Variations.*—The variations are very numerous and the species is quite irregular, but only the pleurocyst is affected externally, for in the interior the zooecia and the apertura are very constant in their form and their micrometric dimensions.

The peristomial avicularia, which are salient and visible (figs. 16, 19), are often more or less deeply imbedded and then become invisible (figs. 17, 18).

The ascopore, more or less removed from the peristomice (figs. 16, 17), approaches it (fig. 18), and even rather frequently opens into the peristomie itself (fig. 19).

The species may have two adventitious avicularia on a zooecium (fig. 17), which still more complicates the zooecial irregularities. Their occurrence appear much less constant on the ovarian zooecia (fig. 12).

In the interior (fig. 13) the ascopore is stellate and of rather variable form.

In tangential section (fig. 14) it will be noted that the adventitious avicularia result often from the coalescence of many areolae. Above many of the zooecia there is a pore hardly visible exteriorly but which is much more constant in the other species. The pleurocystal elements are rather large, scattered, without manifest orientation. Finally, the line of juncture of the zooecia is finely undulating, a feature which is very rare. The zooecial walls are very thick and the areolar cavities are true pore-tubes.

*Affinities.*—This species differs from *Adeonellopsis* (*Poricella*) *elongata* Canu, 1907, from the French Lutetian, in its somewhat larger micrometric dimensions, in its prominent adventitious avicularia, its ascopore smaller externally, and in the proximal lip of the aperture, which is convex and not concave. It differs from *Adeonellopsis grandis* in its very small zoarium and in the absence of a cribriform area on the gonoecia.

*Occurrence.*—Claibornian (Gosport sand): One mile southwest of Rockville, Clarke County, Alabama (common).

Lower Jacksonian (Moodys marl): Jackson, Mississippi (rare).

*Cotypes.*—Cat. No. 63854, U.S.N.M.

### ADEONELLOPSIS GRANDIS, new species.

Plate 99, figs. 11–18.

*Description.*—The zoarium is free, bilamellar, dichotomously branched, often attaining more than 2 centimeters in length; the two lamellae are placed back to back and are separated with difficulty. The ordinary zooecia are elongated, distinct, lozenge-shaped, and separated by a furrow. The peristome is almost complete and bears a large distal pore; the peristomie, which is rather deep, contains a small, straight avicularium, triangular on the old zooecia and round on the young, and a well-hidden aperture; the peristomice is in the form of a crescent on the young zooecia and rather regularly elliptical on the old ones. The ascopore is stellate, very small, and close to the peristomial avicularia. On the line of the areolae there are one or two round, simple, and little salient avicularia. The gonoecia are larger than the ordinary zooecia; their ascopore is replaced by a deep cribriform area perforated by four to six pores.

*Measurements.*—Zooecia $\begin{cases} Lz=0.44 \text{ mm.} \\ lz=0.20\text{–}0.22 \text{ mm.} \end{cases}$ Gonoecia $\begin{cases} Lzg=0.44\text{–}0.50 \text{ mm.} \\ lzg=0.30 \text{ mm.} \end{cases}$

External aperture (width) $\begin{cases} \text{Zooecia}=0.06 \text{ mm.} \\ \text{Gonoecia}=0.10 \text{ mm.} \end{cases}$

*Variations.*—The peristomial avicularium is round when it is prominent (figs. 12, 15), but on the old zooecia with very thick walls it becomes triangular and pointed; this transformation is quite remarkable, but it still does not permit one to discover the function of the organ itself. The ascopore is visible only on the young zooecia (fig. 14). On the others it is placed in the peristomice below the avicularium but always quite visible.

In thin transverse sections (fig. 16) the zooecia are very thick. The pleurocystal elements, piled one on the other are grouped in transversal filaments.

In tangential section, the ascopore is rarely distinct from the avicularium (figs. 17, 18) because they are very close to one another.

*Affinities.*—This species differs from *Adeonellopsis transversa* in its peristomial avicularium, which is straight and not oblique, and in the size of the zoarium. The zoarial dimensions permit the species to be classified among the good-sized fossils useful in field determination.

In its distal pore it resembles *Adeonellopsis cyclops*, but differs from it in the absence of the cribriform area on the ordinary zooecia.

*Occurrence.*—Vicksburgian ("Chimney rock" of Marianna limestone): One mile north of Monroeville, Alabama (very abundant).

*Cotypes.*—Cat. No. 64319, U.S.N.M.

### ADEONELLOPSIS GALEATA, new species.

Plate 99, figs. 1–10.

*Description.*—The zoarium is free, bilamellar, erect, formed of short, dichotomously divided fronds; the two lamellae, placed back to back, are inseparable.

The zooecia are elongated, distinct, elliptical, surrounded by numerous parietal areolae. The cribriform area is wide, perforated by at least seven stellate pores. The peristome is much developed above the aperture and *caps* the zooecia with a large convexity, supporting a small, round avicularium. The aperture is transverse and semielliptical; the peristomie is quite deep. At the base of each zooecium there is a small, simple, adventitious, very salient avicularium.

*Measurements.*—Zooecia $\begin{cases} Lz=0.45\text{–}0.52 \text{ mm.} \\ lz=0.25 \text{ mm.} \end{cases}$
Width of the peristomice=0.14 mm.
Length of the total area=0.15–0.20 mm.

*Variations.*—Our description is based on young zooecia (fig. 2). Quite frequently the development of the pleurocyst reunites in a single total area the aperture, median avicularium, and the cribriform area.

The median avicularium normally round, is more elongated and pointed if it be deeply imbedded (figs. 3, 4). The small distal avicularium is not very constant on the old zooecia (fig. 6). The adventitious avicularium is less prominent on the old zooecia, but it remains visible (fig. 7). The distal thickening of the peristome which caps most of the zooecia disappears at the base of the old fronds (figs. 4, 6).

The older zooecia as usual lose their polypide and consequently their hydrostatic system. They contain only parietal areolae and avicularia (fig. 6). The latter persist even after regeneration.

There are sometimes two and three pores on the distal part of the prominence above the zooecia (figs. 2, 3).

The longitudinal section (fig. 10) shows very well the identity in structure of this fossil form with that of the recent species so well figured by Waters. The depth of the vestibule accounts for the invisibility of the aperture.

The tangential thin section (fig. 8) indicates that the pleurocystal elements are rather large.

*Affinities.*—The old zooecia are exactly like those of *Adeonellopsis cyclops*, but the young zooecia differ from that species in their zooecial cap and in the fact that they lack a thin peristome.

*Adeonellopsis galeata* differs from *A. quisenberryae* in its median avicularium, which is straight and which never touches the walls of the total area.

It differs from *Adeonellopsis magniporosa* in the distal thickening of its peristome and the presence of a small distal avicularium.

*Occurrence.*—Vicksburgian (Byram marl): Byram, Mississippi (common).

Vicksburgian (Marianna limestone): Two and one-half miles north of Millry, Washington County, Alabama (rare); Deep well, Escambia County, Alabama.

Vicksburgian (Red Bluff clay): Red Bluff, Wayne County, Mississippi (rare).

*Cotypes.*—Cat. No. 64318, U.S.N.M.

### ADEONELLOPSIS CYCLOPS, new species.

Plate 100, figs. 1–11.

*Description.*—The zoarium is free, erect, bilamellar, formed of small dichotomously branching fronds; the two lamellae, placed back to back, are inseparable. The zooecia are distinct, elongated, elliptical, bordered by numerous parietal areolae. The marginal zooecia are very long, and without distal avicularia on the peristome or median avicularium and with a very small cribriform area. The median zooecia are wide; their cribriform area is large and of little depth, and the median avicularium is round and prominent. The peristomice is crescent shaped; the peristome thin and sharp, bears a small, round avicularium. The zooecia bear in their inferior part one or two small adventitious avicularia. The old zooecia have thick walls and their aperture, cribriform area and avicularia are arranged at the bottom of a total area.

*Measurements.*—Zooecia $\begin{cases} Lz=0.50\text{–}0.56 \text{ mm.} \\ lz=0.30\text{–}0.32 \text{ mm.} \end{cases}$ Aperture $\begin{cases} ha=0.06 \text{ mm.} \\ la=0.10\text{–}0.15 \text{ mm.} \end{cases}$

*Variations.*—On very young zooecia the parietal areolae are quite large (fig. 6) but they are somewhat smaller on the others (fig. 3).

The thickening of the pleurocyst is visible on figures 3, 4, 6, 8. When the zooecia are old the total area occurs constantly. But in this species, this condition is retarded and the normal zooecia are much greater in number than the old zooecia.

At the base of the zoaria the zooecia, no longer having a polypide, have closed apertures; only the avicularium and the areolae persist (fig. 7). The small peristomal pore is absent in the marginal zooecia (fig. 3) and very small at the ends of the fronds (fig. 6): but it is constant and rather large in the axial zooecia.

On the old zooecia, which are much thickened (fig. 9), it disappears or is irregularly placed. This pore, situated on the thin peristome and the rarity of the old zooecia provided with a total area, characterize this species.

The adventitious avicularia result from the coalescence of two or three areolar cavities; they never have a pivot and are of the most simple type.

*Affinities.*—This species differs from *Adeonellopsis galeata* in the occurrence of the marginal zooecia different from the others and in its thin peristome. It may be distinguished from *Adeonellopsis magniporosa* and from *A. quisenberryae* by the presence of a small distal peristomial avicularium.

*Occurrence.*—Vicksburgian (Marianna limestone): West bank Conecuh River, Escambia County, Alabama (abundant); Murder Creek, east of Castlebury, Alabama (abundant); near Claiborne, Alabama (abundant).

Vicksburgian (Red Bluff clay): Seven and one-half miles southwest of Bladon Springs, Alabama (very rare).

Vicksburgian (Byram marl): Byram, Mississippi (very rare).

*Cotypes.*—Cat. No. 64321, U.S.N.M.

### Genus DIMORPHOCELLA Maplestone, 1903.

1903. *Dimorphocella* MAPLESTONE, Further descriptions of the Tertiary Polyzoa of Victoria, Article IX, Transactions Royal Society Victoria, p. 140.

"Two distinct forms of cells. Zooecial cells elongated or rhomboidal, distinct. Thyrostome [aperture] arched above, with a sinus in the lower lip. Ooecial cells [gonoecia] much larger than the zooecia, elongate, pyriform or oval, with a broad aperture and a perforated area in front." (Maplestone.)

*Genotype.—Dimorphocella* (*Adeonella*) *triton* MacGillivray, 1895. Miocene.

The other known species of this genus are:

*Dimorphocella pyriformis* Maplestone, 1903. Miocene.

*Dimorphocella portmarina* Maplestone, 1903. Recent.

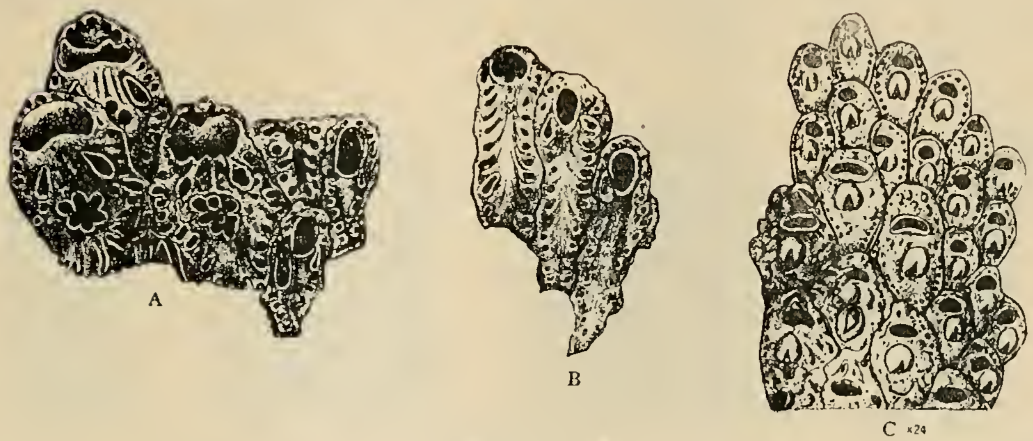

FIG. 170.—Genus *Dimorphocella* Maplestone, 1903.

A, B. *Dimorphocella triton* MacGillivray, 1895. A. Group of zooecia, including gonoecia. B. Normal zooecia. (A, B after MacGillivray, 1895.)

C. *Dimorphocella portmarina* Maplestone, 1903. Group of zooecia, × 24. (After Maplestone, 1903.)

According to the definition and examination of the figures the ordinary zooecia have no ascopores, whereas the gonoecia are provided with them. On the recent species *Dimorphocella portmarina* there are some ascopores on the two kinds of zooecia. Further study is therefore necessary to establish the validity of this genus.

### Genus LAMINOPORA Michelin, 1842.

1842. *Laminopora* MICHELIN, Magasin de Zoologie, pl. 3.

The apertura is very elongate; the anter is semielliptical; the poster bears a long, rounded rimule; two small cardelles separate the two latter parts; the operculum bears two lateral denticles articulating on the cardelles. The frontal is a tremocyst with pores not stellate. The gonoecia have no special form. 13–15 tentacles.

*Genotype.—Laminopora contorta* Michelin, 1842. Recent.

*Gemellipora arbuscula* Calvet, 1907, belongs to this genus.

## Family PHYLACTELLIDAE Canu and Bassler, 1917.

The ovicell is recumbent; its orifice is very large and closed by a special operculum. "The larvae are large and more fully developed within the ovicell than is usual; the corona and cilia are very distinct."

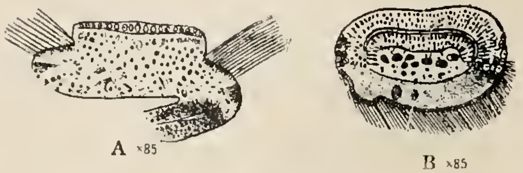

Fig. 171.—Larva of Phylactellidae.

A, B. *Phylactella labiata* Smitt, 1867. Two views of the large larva in the ovicell, × 85, showing the larva to be more fully developed than in other bryozoa.

In 1900 Waters[1] discovered the larva of *Phylactella*. It is quite distinct from all others in its form and its large dimensions, and evidently it characterizes a special family. The principal genus was outlined by Hincks, but he has not completely defined it.

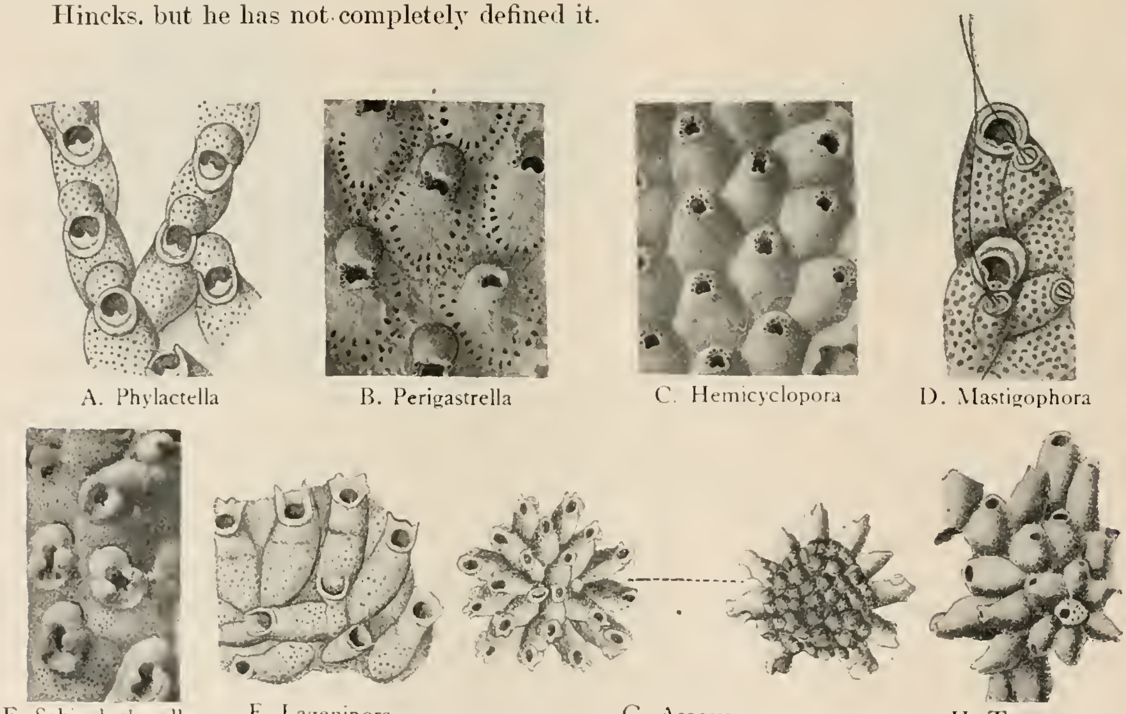
A. Phylactella
B. Perigastrella
C. Hemicyclopora
D. Mastigophora
E. Schizobathysella
F. Lagenipora
G. Ascosia
H. Temachia

Fig. 172. Genera of the family Phylactellidae Canu and Bassler, 1917.

A. *Phylactella labrosa* Busk, 1852, × 30. Recent.
B. *Perigastrella hexagonalis*, new species, × 20. Jacksonian of North Carolina.
C. *Hemicyclopora parajuncta* Canu and Bassler, 1917, × 20. Jacksonian of South Carolina.
D. *Mastigophora hyndmanni* Johnston, 1847, × 30. Recent.
E. *Schizobathysella saccifera* Canu and Bassler, 1917, × 20. Jacksonian of North Carolina.
F. *Lagenipora socialis* Hincks, 1877, × 25. Recent.
G. *Ascosia pandora* Jullien, 1882, × 10. Recent.
H. *Temachia opulenta* Jullien, 1881, × 8.5. Recent.

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[1] 1900, Waters, Bryozoa from Franz Josef Land, Journal Linnean Society London, Zoology, vol. 28, p. 90, pl. 12, figs. 3, 4.

The special ovicell which Waters called recumbent is placed on the distal part of the zooecium itself between the apertura and the distal zooecium. Viewed laterally it appears attached like a sack on the back of a porter. Evidently it is also more or less supported on the distal zooecium, but frequently it is completely separated from it. In its form, position, and large opening it is eminently adapted to the size of the larvae.

We know but little of the opercular system. The three opercula which we know have been figured by Waters.

The determination of the species presents some difficulties. The tremopores and the areolae are very small; they become obliterated quite easily and the true nature of the frontal is difficulty discernible.

For the classification of the genera we apply always the same principal functions, working of the operculum, compensatrix, calcification. This classification may not always be definite, nor complete for we have only fossil forms at our disposition.

Generally the ancestrula is a very small zooecium provided with a very large elliptical aperture.

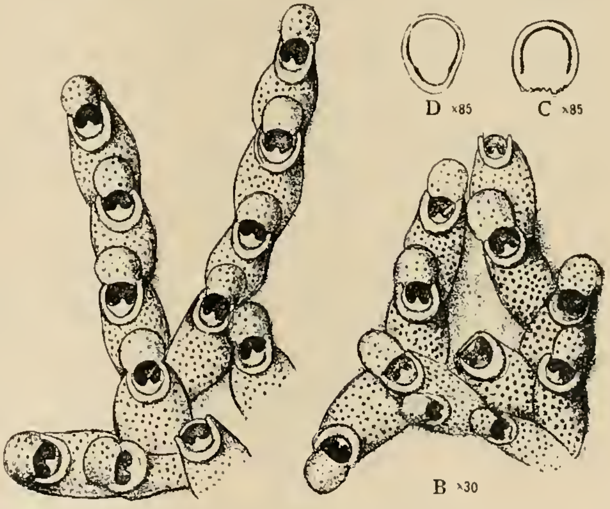

Fig. 173.—Genus *Phylactella* Hincks, 1880.

A, B. *Phylactella labrosa* Busk, 1852. Two groups of zooecia, × 30. (After Hincks, 1880.)

C. Operculum, × 85.

D. *Phylactella punctigera* Waters, 1899. Operculum, × 85. (C, D after Waters, 1899.)

**Genus PHYLACTELLA Hincks, 1880.**

1880. *Phylactella* Hincks, British Marine Polyzoa, p. 356.

The apertura is more or less circular; it bears either a lyrule or some cardelles. The thick band of the operculum is at a small distance from the edge. The apertura is surrounded by a peristomie more or less funnel-shaped; the peristome is interrupted distally and replaced by a small tongue. The frontal is a tremocyst with very fine pores. No spines.

*Genotype.—Phylactella labrosa* Busk, 1852.

*Range.*—Jacksonian—Recent.

The fossil species of this genus are:

*Phylactella* (*Lepralia*) *tubiceps* Reuss, 1865, Chattian of Germany.

*Phylactella porosa* MacGillivray, 1895, Miocene of Australia.

The recent species are:

*Phylactella* (*Lepralia*) *labrosa* Busk, 1852.

*Phylactella* (*Lepralia*) *collaris* Norman, 1866.
*Phylactella* (*Lepralia*) *eximia* Hincks, 1877.
*Phylactella punctigera* Waters, 1899.
*Phylactella columnaris* Kirkpatrick, 1888.

### PHYLACTELLA INFUNDIBULUM Canu and Bassler, 1917.

Plate 71, figs. 24–26.

1917. *Phylactella infundibulum* CANU and BASSLER, Synopsis of American Early Tertiary Cheilostome Bryozoa, Bulletin 96, United States National Museum, p. 67, pl. 6, fig. 2.

*Description.*—The zoarium incrusts other bryozoa. The zooecia are large, distinct, elongated, oval; the frontal is quite convex; it is formed of a tremocyst with very small pores separated from each other by fine granules. The apertura is formed of a large semicircular anter, separated by two cardelles from a very concave poster; the peristome is long, tubular, depressed in front, and interrupted behind by a wide distal tongue; the peristomie forms a sort of *funnel* around the apertura. The ovicell is large, salient, globular, finely porous and granular; it is hyperstomial, recumbent, and it opens into the peristomie.

*Measurements.*—Apertura $\left\{\begin{array}{l} ha=0.16 \text{ mm.} \\ la=0.16\text{–}0.17 \text{ mm.} \end{array}\right.$ Zooecia $\left\{\begin{array}{l} Lz=1.25 \text{ mm.} \\ lz=0.72 \text{ mm.} \end{array}\right.$

This superb species is unfortunately quite rare.

*Occurrence.*—Middle Jacksonian (Castle Hayne limestone): Wilmington, North Carolina (rare).

*Cotypes.*—Cat. No. 62607, U.S.N.M.

### PHYLACTELLA PARVICOLLUM, new species.

Plate 72, fig. 9.

*Description.*—The zoarium incrusts shells. The zooecia are distinct, elongated, elliptical or oval; the frontal is convex and formed of a tremocyst with very small pores separated by small salient granulations. The apertura is orbicular; it is formed of a large anter separated by two small cardelles from a small concave and finely denticulated poster; the peristome is *small*, little salient, often interrupted distally by a small salient tongue.

*Measurements.*—Apertura $\left\{\begin{array}{l} ha=0.15 \text{ mm.} \\ la=0.15 \text{ mm.} \end{array}\right.$ Zooecia $\left\{\begin{array}{l} Lz=0.60 \text{ mm.} \\ lz=0.45\text{–}0.50 \text{ mm.} \end{array}\right.$

*Affinities.*—This charming species is unfortunately rare and we have not had the good fortune to discover the ovicell.

It differs from *Phylactella infundibulum* in its micrometric dimensions, which are twice as small. On the other hand, its zooecial length, 0.60 mm., is much greater than that of *Phylactella parvicella* ($Lz=0.40$ mm.).

*Occurrence.*—Middle Jacksonian (Castle Hayne limestone): Wilmington, North Carolina (rare).

*Holotype.*—Cat. No. 64192, U.S.N.M.

### PHYLACTELLA PARVICELLA, new species.

Plate 71, fig. 27.

*Description.*—The zoarium incrusts bryozoa. The zooecia are relatively *small*, short, distinct, elliptical; the frontal is convex and formed of a tremocyst with very small pores separated by very minute granules. The apertura is elliptical; the peristome is thin, salient, complete.

*Measurements.*—Apertura $\left\{\begin{array}{l} ha=0.10\text{ mm.} \\ la=0.10\text{ mm.} \end{array}\right.$ Zooecia $\left\{\begin{array}{l} Lz=0.40\text{ mm.} \\ lz=0.30\text{ mm.} \end{array}\right.$

*Affinities.*—This is the smallest of our *Phylactella;* it is therefore easy to determine. Unhappily, only the figured specimen has been found, so we are ignorant of the ovicell.

*Occurrence.*—Middle Jacksonian: Baldock, Barnwell County, South Carolina (very rare).

*Holotype.*—Cat. No. 64191, U.S.N.M.

### PHYLACTELLA CRIBRATA, new species.

Plate 96, fig. 10.

*Description.*—The zoarium incrusts bryozoa. The zooecia are elongated, distinct, ovoid; the frontal is convex and formed of a tremocyst with numerous pores in quincunx. The apertura is suborbicular, oblique, little visible exteriorly; the peristome is thin, complete, salient, bearing on its proximal border a wide salient mucro, placed facing the orifice of the ovicell. The ovicell is small, transverse, smooth; it is hyperstomial and recumbent. A triangular avicularium somewhat salient, the point directed toward the top, is placed laterally on a single extremity of the transversal axis of the zooecia.

*Measurements.*—Apertura $\left\{\begin{array}{l} ha=0.16\text{ mm.} \\ la=0.18\text{ mm.} \end{array}\right.$ Zooecia $\left\{\begin{array}{l} Lz=0.65\text{–}0.75\text{ mm.} \\ lz=0.40\text{–}0.45\text{ mm.} \end{array}\right.$

*Affinities.*—This species is very well characterized by its *sieve-like* frontal of tremopores, larger than ordinary, and by its lateral avicularium.

It is to be noted that most of the known *Phylactella* have an aperture whose diameter is close to 0.15–0.17 mm. The genus is a perfectly natural one.

*Phylactella* (*Lepralia*) *tubiceps* Reuss, 1865, of the German Rupelian, is quite close on account of the size of its tremopores and in the presence of an avicularium; it differs from it solely in the absence of a peristomie, an exterior which has given the name to the European species.

Upon examination of more numerous specimens it may be that the two species will be recognized as identical.

*Occurrence.*—Vicksburgian ("Chimney rock" of Marianna limestone): One mile north of Monroeville, Alabama (rare).

*Holotype.*—Cat. No. 64310, U.S.N.M.

### Genus PERIGASTRELLA Canu and Bassler, 1917.

1917. *Perigastrella* CANU and BASSLER, Synopsis of American Early Tertiary Cheilostome Bryozoa, Bulletin 96, United States National Museum, p. 68.

The apertura is semicircular. The band of the operculum is on the border. The frontal is surrounded by one or two rows of small areolae; it is formed of an olocyst supporting a smooth or finely granular pleurocyst. Spines.

*Genotype.*—*Perigastrella* (*Lepralia*) *labiata* Boeck, 1861.

*Range.*—Lutetian—Recent.

The recent species are:

*Perigastrella* (*Lepralia*) *labiata* Boeck, 1861.

*Perigastrella* (*Lepralia*) *contracta* Waters, 1899.

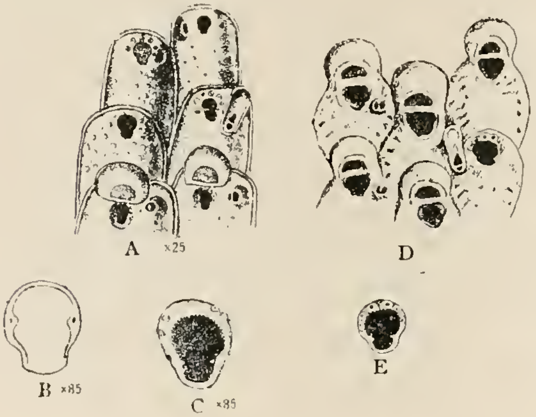

FIG. 174.—Genus *Perigastrella* Canu and Bassler, 1917

A–E. *Perigastrella contracta* Waters, 1899. A. Zooecia, × 25. B, C. Operculum and apertura, × 85. (A-C after Waters, 1899.) D, E. Zooecia and apertura. (After Norman, 1909.)

The fossil species are:

*Perigastrella* (*Mucronella*) *semierecta* Koschinsky, 1885.

*Perigastrella* (*Lepralia*) *grotriani* Stoliczka, 1862.

**PERIGASTRELLA ANSATA, new species.**

Plate 14, figs. 18, 19.

*Description.*—The zoarium incrusts shells. The zooecia are distinct, short, little elongated; the frontal is convex and formed of an olocyst perforated laterally by widely spaced areolae and surmounted by a finely granular pleurocyst. The apertura is formed of a large ogival anter and of a concave poster; the peristome is little salient, very thin, with an inferior lip salient or somewhat depressed on the frontal. The ovicell is small, recumbent, little salient and hyperstomial. On the peristome itself there are sometimes two small, round avicularia.

*Measurements.*—Apertura $\begin{cases} ha=0.14\text{–}0.16 \text{ mm.} \\ la=0.12\text{–}0.14 \text{ mm.} \end{cases}$ Zooecia $\begin{cases} Lz=0.40 \text{ mm.} \\ lz=0.30\text{–}0.34 \text{ mm.} \end{cases}$

The form of the apertura, like the *handle* of a basket, is rather characteristic. Widely spaced areolae have not been observed in any other species. The olocyst and the detachable pleurocyst are clearly visible on figure 19.

*Occurrence.*—Claibornian (Gosport sand): One mile southwest of Rockville, Clarke County, Alabama (rare).

*Cotypes.*—Cat. No. 63853, U.S.N.M.

### PERIGASTRELLA HEXAGONALIS, new species.

Plate 72, fig. 10.

*Description.*—The zoarium incrusts bryozoa. The zooecia are large, distinct, *hexagonal;* the frontal is little concave and surrounded by a double row of quite crowded areolae; it is formed of a granular pleurocyst. The apertura is transverse, oblique, trapezoid, little visible exteriorly; the peristome is little salient, oblique with an inferior lip in the form of a mucro, which is elevated and prominent. The ovicell is small, transverse, globular, granular; it is hyperstomial and recumbent.

*Measurements.*—Apertura $\begin{cases} ha=0.08\text{–}0.10 \text{ mm.} \\ la=0.14 \text{ mm.} \end{cases}$ Zooecia $\begin{cases} Lz=0.80 \text{ mm.} \\ lz=0.70\text{–}0.80 \text{ mm.} \end{cases}$

*Occurrence.*—Middle Jacksonian (Castle Hayne limestone): Wilmington, North Carolina (rare).

*Holotype.*—Cat. No. 64193, U.S.N.M.

### PERIGASTRELLA RHOMBOIDALIS, new species.

Plate 72, fig. 11.

*Description.*—The zoarium is bilamellar; the two lamellae, back to back, are inseparable. The zooecia are distinct, large, elongated, *rhomboidal*; the frontal is convex, surrounded by a double line of small triangular areolae and formed of a finely granular pleurocyst. The peristomice is semilunar, transverse, complete, with a concave proximal border; the peristome is thin, sharp, little salient. The ovicell is small, transverse, little salient, finely granular; it is always closed by the operculum.

*Measurements.*—Apertura $\begin{cases} ha=0.16 \text{ mm.} \\ la=0.22\text{–}0.24 \text{ mm.} \end{cases}$ Zooecia $\begin{cases} Lz=1.00\text{–}1.20 \text{ mm.} \\ lz=0.60\text{–}0.80 \text{ mm.} \end{cases}$

*Affinities.*—The figured specimen only has been found. It appears to represent a type rather divergent in the genus. We believe in making a new genus only when the material is sufficient.

*Occurrence.*—Middle Jacksonian (Castle Hayne limestone): Wilmington, North Carolina (very rare).

*Holotype.*—Cat. No. 64194, U.S.N.M.

### PERIGASTRELLA CYCLORIS Gabb and Horn, 1862.

Plate 72, figs. 12–14.

1862. *Cellepora cycloris* GABB and HORN, Monograph Polyzoa Secondary and Tertiary formations of North America, Journal Academy Natural Sciences, Philadelphia, ser. 2, vol. 5, p. 127, pl. 19, fig. 9.

1890. *Cellepora cycloris* DE GREGORIO, Monograph Fauna Eocenique de l'Alabama, Annales Geologie et Paleontologie, Livr. 7 and 8, p. 247, pl. 43, fig. 1.

*Description.*—The zoarium incrusts shells and bryozoa. The zooecia are distinct, large, hexagonal; the frontal is very convex and surrounded by a triple row of very small areolae; it is formed of a smooth or very finely granular pleurocyst. The apertura is hidden at the base of a large peristomie; it is transverse (interior) and formed of a semielliptical anter separated by two small cardelles from a somewhat concave poster; the peristome is very salient. thin; its distal part supports eight spines; its proximal part bears a wide, very salient mucro perpendicular to the zooecial plane or depressed on the frontal. The ovicell is small, salient, globular, smooth; it is hyperstomial and recumbent.

*Measurements.*—Apertura $\begin{cases} ha=0.12 \text{ mm.} \\ la=0.14\text{–}0.18 \text{ mm.} \end{cases}$ Zooecia $\begin{cases} Lz=0.80\text{–}1.00 \text{ mm.} \\ lz=0.70\text{–}0.80 \text{ mm.} \end{cases}$

*Affinities.*—This large and beautiful species has been known for a long time. The transversal schematic section of a zooecium given by Gabb and Horn is perfectly exact. The labial mucro is placed in such a position that our photographs can not show their important saliency.

The operculum may never close the ovicell.

This species differs from *Perigastrella semierecta* Koschinsky, 1885, in its larger dimensions ($Lz=0.80$ and not 0.70 mm.) and the different disposition of the labial mucro.

*Occurrence.*—Middle Jacksonian: Wilmington, North Carolina (common); near Lenuds Ferry, South Carolina (very rare).

Upper Jacksonian (Ocala limestone): West bank Sepulga River, Escambia County, Alabama (rare).

*Plesiotypes.*—Cat. No. 64195, U.S.N.M.

### PERIGASTRELLA OSCITANS, new species.

Plate 72, figs. 15–18.

*Description.*—The zoarium incrusts shells, often over a very large surface. The zooecia are distinct, elongated, elliptical; the frontal is convex and surrounded by a line of round or triangular areolae; it is formed of a granular pleurocyst. The apertura (interior) is oblique, transverse, trapezoid; the peristomie, rather deep, often bears two or three very prominent denticles; the peristome is thin, salient, complete; it bears six spines on its distal part and the proximal part is a wide salient mucro. erect, and partially hiding the apertura. The ovicell is small, transverse, salient, very widely open; its pleurocyst does not entirely cover the olocyst, thus leaving a very apparent frontal area.

*Measurements.*—Apertura $\begin{cases} ha=0.08 \text{ mm.} \\ la=0.08\text{–}0.10 \text{ mm.} \end{cases}$ Zooecia $\begin{cases} Lz=0.60\text{–}0.70 \text{ mm} \\ lz=0.30\text{–}0.40 \text{ mm.} \end{cases}$

*Variations.*—It is difficult to find good specimens of this species, for they are easily altered by fossilization; the apertura is always more or less closed by the calcareous deposit. We have succeeded, however, in preparing a superb specimen (fig. 15) in the vicinity of the ancestrula; the areolae are there quite small and the labial mucro is much attenuated. The more habitual aspect of the species is that of our figure 16.

On the well-preserved specimens (notably those from Wilmington), by inclining the preparation, we can see in the peristomie two or three salient denticles of whose physiologic significance we are ignorant.

The frontal is often smooth (fig. 17).

The orifice of the ovicelled zooecia has somewhat the aspect of a human mouth opened to yawn.

*Affinities.*—This species is distinguished from *Perigastrella elegans* by its large general dimensions and the absence of three rows of areolar pores.

It is distinguished from *Perigastrella ovoidea* in the elliptical form of its zooecia, its lesser zooecial length ($Lz=0.70$ and not 0.80 mm.), its less convex frontal, its wider and larger ovicell with two quite visible lamellae.

It is distinguished from *Perigastrella plana* in its smaller micrometric dimensions ($lz=0.40$ and not 0.50–0.60 mm.) and in its pleurocyst, which is complete instead of being lateral only.

*Occurrence.*—Lower Jacksonian (Moodys marl): Jackson, Mississippi (rare).

Middle Jacksonian: Wilmington, North Carolina (common); 3¼ miles south of Perry, Georgia (rare); 12 miles southeast of Marshallville. Georgia (rare); Rich Hill, Crawford County, Georgia (rare); Eutaw Springs, South Carolina (rare); one-half mile southeast of Georgia Kaolin Company Mine, Twiggs County, Georgia (rare); 17 miles northeast of Hawkinsville, Georgia.

Upper Jacksonian (Ocala limestone): West bank of Sepulga River, Escambia County, Alabama (rare); old factory, 1½ miles above Bainbridge, Georgia (rare).

*Cotypes.*—Cat. No. 64196, U.S.N.M.

### PERIGASTRELLA ELEGANS, new species.

Plate 73, fig. 1.

*Description.*—The zoarium incrusts shells. The zooecia are distinct, a little elongated, small, elliptical; the frontal is convex and surrounded by two or three rows of round or triangular areolar pores; it is formed of a very finely granular pleurocyst. The apertura is deep, trapezoid; the peristome is complete, thin, salient; its inferior lip is a very salient mucro, hiding somewhat the apertura or depressed on the frontal. The ovicell is very small, little salient, and formed of a pleurocyst and an olocyst which are distinct from each other.

*Measurements.*—Apertura $\begin{cases} ha=0.08 \text{ mm.} \\ la=0.10 \text{ mm.} \end{cases}$ Zooecia $\begin{cases} Lz=0.55 \text{ mm.} \\ lz=0.30\text{–}0.35 \text{ mm.} \end{cases}$

*Affinities.*—This elegant species much resembles *Perigastrella oseitans* in the absence of decided characters and appears to be a minor variety of it. It differs from it in its much smaller micrometric dimensions, less than 0.55 mm., in its smoother ovicell, and its three rows of areolar pores.

*Occurrence.*—Middle Jacksonian: Baldock, Barnwell County, South Carolina (rare).

*Holotype.*—Cat. No. 64197. U.S.N.M.

### PERIGASTRELLA OVOIDEA Canu and Bassler, 1917.

Plate 73, figs. 2–4.

1917. *Perigastrella ovoidea* Canu and Bassler, Synopsis of American Early Tertiary Cheilostome Bryozoa, Bulletin 96, United States National Museum, p. 68, pl. 6, fig. 8.

*Description.*—The zoarium incrusts shells. The zooecia are distinct, elongated, large, *ovoid*; the frontal is very convex, bordered by very small areolar pores and formed of a very finely granular pleurocyst almost smooth. The apertura, almost invisible exteriorly, is trapezoidal and oblique; the peristomie is deep; the peristome is very oblique and bears six to eight spines; it is sometimes interrupted in front, but more often it bears a salient mucro, oblique or erect, hiding more or less the apertura; there is a small lyrula in the apertura. The ovicell is small, salient, globular, almost entirely detached from the distal zooecium; it is hyperstomial and recumbent; its frontal is finely granular like the zooecia. The ancestrula is very small, but identical in form with the other zooecia.

*Measurements.*—Apertura $\left\{\begin{array}{l} ha=0.05 \text{ mm.} \\ la=0.08\text{–}0.10 \text{ mm.} \end{array}\right.$ Zooecia $\left\{\begin{array}{l} Lz=0.75\text{–}0.80 \text{ mm.} \\ lz=0.50 \text{ mm.} \end{array}\right.$

*Affinities.*—This beautiful species is quite recognizable by its very large zooecial convexity. It differs from *Perigastrella semierecta* Koschinsky, 1885, in the presence of spines and in its somewhat larger dimensions.

It differs from *Perigastrella oscitans* in its very small and nearly invisible areolae, its large frontal convexity, and its peristomice, three times smaller, and in its oral lyrula.

It also resembles the ancestrular zooecia of *Perigastrella cycloris* Gabb and Horn, 1862, but differs in the apertura, which bears a lyrula and no cardelles.

*Occurrence.*—Middle Jacksonian: Eutaw Springs, South Carolina (common).

Upper Jacksonian (Ocala limestone): Plant System Railroad wharf at Bainbridge, Georgia (common); Old Factory, 1½ miles above Bainbridge, Georgia (rare); Red Bluff, on Flint River, 7 miles above Bainbridge, Georgia (rare); west bank Sepulga River, Escambia County, Alabama (rare); Chipola River, east of Marianna Jackson County, Florida (very rare).

Vicksburgian (Marianna limestone): Well, Escambia County, Alabama.

*Cotypes.*—Cat. No. 62613, U.S.N.M.

### PERIGASTRELLA MAXILLA, new species.

Plate 73, figs. 5–7.

*Description.*—The zoarium incrusts shells and other bryozoa. The zooecia are distinct, short, ovoid, erect; the frontal is very convex, almost smooth, surrounded by minute areolae, revealed only by some scarcely visible roughnesses. The apertura is deep, oblique, trapezoid, with a straight or somewhat convex proximal border; the peristomie is tubular, large; it is terminated by a peristome with usually eight spines and by a very large, rounded, salient, erect mucro, exposing to view the apertura and almost invariably depressed on the frontal. The ovicell is transverse, globular, salient, and formed of a pleurocyst on an olocyst; it is hyperstomial, recumbent, and somewhat supported on the distal zooecium.

*Measurements.*—Apertura $\left\{\begin{array}{l} ha=0.06 \text{ mm.} \\ la=0.12 \text{ mm.} \end{array}\right.$ Zooecia $\left\{\begin{array}{l} Lz=0.60 \text{ mm.} \\ lz=0.36\text{–}0.40 \text{ mm.} \end{array}\right.$

*Variations.*—The mucro arises just in front of the orifice of the ovicell; its size depends strangely enough on the development of the ovicell. But its aspect is very irregular; sometimes it is erect (fig. 5). Sometimes it appears as depressed on the frontal (fig. 6). The greater part of the time the frontal appears smooth and the areolae are discernible only on perfect and very well cleaned specimens.

*Affinities.*—This species differs from *Perigastrella ovoidea* in its small dimensions ($Lz=0.60$ and not 0.80 mm.), in the absence of lyrula, in the apertura, and in its larger ovicell.

It differs from *Perigastrella trapezoidea*, *P. depressa*, and *P. rectilineata*, whose aspect is equally smooth, in its more convex frontal, and especially in the great development of its peristomie and its labial mucro.

*Occurrence.*—Middle Jacksonian: Rich Hill, Crawford County, Georgia (rare); 18 miles west of Wrightsville, Johnson County, Georgia (rare).

*Cotypes.*—Cat. Nos. 64198, 64199, U.S.N.M.

### PERIGASTRELLA TRAPEZOIDEA, new species.

Plate 73, figs. 8, 9.

*Description.*—The zoarium incrusts bryozoa and shells. The zooecia are distinct, somewhat elongated, irregularly hexagonal; the frontal is little convex, without distinct exterior peristomie, surrounded by a double line of very small areolae and formed of a finely granular pleurocyst. The apertura is *trapezoidal*, visible exteriorly, sometimes a little deformed by the mucro; the peristome is little salient; it bears six to eight spines on its distal part and a wide mucro erect, projecting in the form of a proximal lip. The ovicell is globular, salient, transverse, somewhat supported on the distal zooecium, finely granulated; it is hyperstomial and recumbent.

*Measurements.*—Apertura $\left\{\begin{array}{l} ha=0.06 \text{ mm.} \\ la=0.10 \text{ mm.} \end{array}\right.$ Zooecia $\left\{\begin{array}{l} Lz=0.50 \text{ mm.} \\ lz=0.40\text{–}0.50 \text{ mm.} \end{array}\right.$

*Variations.*—The areolae and the frontal granulations are so small that the zooecia often seem nearly smooth. The tongue, which serves as a mucro, is generally erect and very prominent just in front of the orifice of the ovicell, but often it is somewhat oblique and partially hides the apertura.

*Affinities.*—This species differs from *Perigastrella oscitans* in its less elongated zooecia, its much smaller granulations, its ovicell with no distinct and visible olocyst, and in its very small, scarcely visible areolae.

The difference from *Perigastrella maxilla* is little apparent in superficial observation. It differs from it in its less elevated zooecia, its flatter frontal, its mucro never depressed on the frontal, and chiefly in the absence of an exteriorly visible peristomie.

It differs from *Perigastrella depressa*, of which it has the zooecial form and general appearance, in the presence of its spines, in its frontal granulations, and in its labial mucro.

The difference between it and *Hemicyclopora parajuncta* is quite small; it differs from it, however, in its visible areolae, its much larger labial mucro, and in its frontal granulations.

It differs from *Perigastrella ovoidea* in its smaller dimensions ($Lz$=0.50 and not 0.75 mm.) and in its transversal and trapezoidal apertura.

*Occurrence.*—Middle Jacksonian: Wilmington, North Carolina (common); near Lenuds Ferry, South Carolina (common).

*Cotypes.*—Cat. No. 64200, U.S.N.M.

### PERIGASTRELLA DEPRESSA, new species.

Plate 73, figs. 10–13.

*Description.*—The zoarium incrusts bryozoa and shells. The zooecia are very little elongated, distinct, irregularly hexagonal; the frontal is little convex, bordered by very small areolae, and formed of a nearly smooth pleurocyst detachable from the subjacent olocyst. The apertura is semilunar, transverse, with a straight or slightly convex proximal border; the peristome is scarcely salient; its proximal border is *depressed*, never salient, sometimes inclined toward the apertura. The ovicell is large, smooth, partially fixed to the distal zooecium; its orifice is little visible exteriorly.

*Measurements.*—Apertura $\begin{cases} ha=0.06\text{–}0.08 \text{ mm.} \\ la=0.12\text{–}0.14 \text{ mm.} \end{cases}$ Zooecium $\begin{cases} Lz=0.50 \text{ mm.} \\ lz=0.40\text{–}0.50 \text{ mm.} \end{cases}$

*Variations.*—The zooecial form of this species is rather variable and can not serve for determination. The areolae are invisible most of the time; only the perfect specimens are provided with them. But the essential characters of this species are easy to recognize: orifice of the ovicell invisible, entire absence of salient labial mucro.

*Affinities.*—This species much resembles *Perigastrella trapezoidea;* it differs from it in its still flatter frontal, in the absence of a salient labial mucro, and in its almost smooth zooecia.

It differs from *Hemicyclopora parajuncta* in its areolae, sometimes visible, in the absence of labial mucro, and in its ovicell, which is better attached, more fixed to the distal zooecium.

*Occurrence.*—Middle Jacksonian: Wilmington, North Carolina (common); near Lenuds Ferry, South Carolina (rare).

*Cotypes.*—Cat. No. 64201, U.S.N.M.

### PERIGASTRELLA RECTILINEATA, new species.

Plate 73, figs. 14–19.

*Description.*—The zoarium incrusts shells and bryozoa; the zooecia are disposed in *linear rows*. The zooecia are distinct, elongated, elliptical; the frontal is smooth, surrounded by a line of minute areolae; it is convex transversely and concave longitudinally. The apertura is little visible exteriorly, transverse, semielliptical with a proximal border slightly convex: the peristome is very little salient and bears six distal spines; its proximal lip is a little salient palette more or less oblique; partially hiding the apertura, and whose lateral borders are straight. The ovicell is globular, smooth, salient, fixed in part on the distal zooecium; it is hyperstomial and recumbent; its orifice is rarely visible exteriorly.

*Measurements.*—Apertura $\left\{\begin{array}{l} ha=0.04 \text{ mm.} \\ la=0.08\text{–}0.12 \text{ mm.} \end{array}\right.$ Zooecia $\left\{\begin{array}{l} Lz=0.40 \text{ mm.} \\ lz=0.30 \text{ mm.} \end{array}\right.$

*Variations.*—The zooecia grouped in long, linear, adjacent series, characterize quite well this species (fig. 19); however, many zoaria have their zooecia regularly disposed in quincunx (figs. 16, 17).

The areolae are rarely visible; the aspect of the frontal is then absolutely smooth. However, after brushing and washing with patience some specimens, we have been able to discover the areolae; they are extremely small, but their reality is not to be doubted. At the extremity of the large zoaria the zooecia are rather large.

This species may easily be recognized at first glance by the peculiar disposition of its labial mucro; it has straight borders and is clearly detached on the wider apertura, which appears thus ornamented laterally with two sorts of linear or circular opesiules.

In the interior the olocyst presents some kinds of fibers radiating from the apertura (fig. 18).

On one specimen we have observed a membraniporoid ancestrula.

*Affinities.*—In its smooth zooecia it resembles *Hemicyclopora parajuncta;* it differs from it in its smaller zooecia ($Lz=0.30$ and not 0.50 mm.), never longitudinally concave, in larger labial mucro, and in being bordered by false opesiules.

It differs from *Perigastrella depressa* in its smaller zooecia ($Lz=0.40$ and not 0.50 mm.), in the presence of a labial mucro, and in its much more convex frontal.

*Occurrence.*—Lower Jacksonian (Moodys marl): Jackson, Mississippi (rare).

Middle Jacksonian: Wilmington, North Carolina (common).

Vicksburgian (Marianna limestone): Salt Mountain, 5 miles south of Jackson, Alabama (rare); 1 mile north of Monroeville, Alabama (rare).

*Cotypes.*—Cat. Nos. 64202, 64203, U.S.N.M.

### PERIGASTRELLA PLANA, new species.

Plate 100, figs. 18–21.

*Description.*—The zoarium incrusts shells. The zooecia are distinct, elongated, rather large, oval; the frontal is almost *flat*, bordered by a double row of small prominent areolae and formed of a smooth or granular pleurocyst. The apertura is semielliptical, transverse, with a straight, finely crenulated proximal border; the peristome is complete, salient, thick; it bears six distal spines and a wide, convex, salient, oblique, labial mucro. The ovicell is salient, transverse; its orifice is quite visible exteriorly and placed just in front of the labial mucro; it is hyperstomial, recumbent, somewhat supported on the distal zooecium; it is smooth and formed like the frontal of an olocyst under a pleurocyst.

SHORT HEXAGONAL ZOOECIA.

*Measurements.*—Apertura $\left\{\begin{array}{l} ha=0.08 \text{ mm.} \\ la=0.14 \text{ mm.} \end{array}\right.$ Zooecia $\left\{\begin{array}{l} Lz=0.60 \text{ mm.} \\ lz=0.40\text{–}0.50 \text{ mm.} \end{array}\right.$

LONG ZOOECIA.

Apertura $\left\{\begin{array}{l} ha=0.10 \text{ mm.} \\ la=0.14 \text{ mm.} \end{array}\right.$ Zooecia $\left\{\begin{array}{l} Lz=0.64\text{–}0.70 \text{ mm.} \\ lz=0.50\text{–}0.60 \text{ mm.} \end{array}\right.$

*Variations.*—The exterior peristomie is little visible by the illumination from above in our figures; it is more accentuated under the microscope by illumination from below. The young zooecia have a complete peristome (figs. 20, 21) and the areolae are quite visible. On old zooecia the pleurocystal calcification is intense in the vicinity of the areolae, so that the zooecia appear to be surrounded by a wide collar (figs. 18, 19). Sometimes in the interior of the peristomie there are two or three denticles; their fragility is perhaps the cause of their rarity.

*Affinities.*—The greater affinities of this species are with *Perigastrella oscitans*, and near the ancestrula confusion is possible. *Perigastrella plana* differs from it in its greater width (*lz*=0.40–0.60 and not 0.30–0.40 mm.); in the oval, nonelliptical form of the zooecia, and in the proximal border of the crenulated apertura.

*Occurrence.*—Vicksburgian (Marianna limestone): West bank Conecuh River, Escambia County, Alabama (rare); Murder Creek, east of Castlebury, Conecuh County, Alabama (common); near Claiborne, Monroe County, Alabama (very common); one mile north of Monroeville, Alabama (very common); Salt Mountain, five miles south of Jackson, Alabama (common).

Vicksburgian (Byram marl): Byram, Mississippi (rare).

*Cotypes.*—Cat. Nos. 63918, 64324, U.S.N.M.

### PERIGASTRELLA? COSTIFERA, new species.

Plate 100, figs. 12–17.

*Description.*—The zoarium is incrusting cylostome bryozoa. The zooecia are distinct, elongated, fusiform, provided at their extremity with a long exterior peristomie; the frontal is somewhat convex and bordered laterally with widely spaced areolae; it is formed of a pleurocyst with interareolar *costules* more or less long. The apertura, invisible exteriorly, appears orbicular and oblique. The peristomice is irregular, oblique, with four distal spines. The ovicell is small, hyperstomial, recumbent, opening into the peristome.

*Measurements.*—Zooecia $\left\{\begin{array}{l} Lz=0.35\text{–}0.45 \text{ mm.} \\ lz=0.20\text{–}0.25 \text{ mm.} \end{array}\right.$

*Affinities.*—On account of its orbicular orifice and its large peristomie, this species may be classed approximately in *Lagenipora* Hincks, 1880. Waters, in 1899, limited this genus to only those species whose ovicell is provided with a cribriform area. We are ignorant of the physiologic significance of this area, and we are unable to discuss the subject from a study of more or less well-preserved fossil forms.

This species differs from *Perigastrella tubulosa*, which is also provided with a long peristomie, in its interareolar costules, and in its smaller micrometric dimensions ($L\dot{z}$=0.45 and not 0.65 mm.).

*Perigastrella grotiani* Reuss, 1865, is also provided with an exterior tubular peristomie, but our species differs in its more scattered areolae and in the presence of interareolar costules.

It is to be noted that this species does not spread out into flabelliform zoaria. We have observed it only on very narrow substrata, such as would be offered by the cyclostome bryozoa. It is not possible to comprehend how a wide substratum is capable of destroying larvae; we must therefore admit that a larva is capable of choosing its substratum, which is marvelous in the obscure depths of the sea. Such symbiosis is frequent everywhere in the bryozoa.

*Occurrence.*—Vicksburgian (Marianna limestone): West bank of Conecuh River, Escambia County, Alabama (common); Murder Creek, east of Castlebury, Alabama (very rare).

*Cotypes.*—Cat. No. 64323, U.S.N.M.

### PERIGASTRELLA? TUBULOSA, new species.

Plate 74, fig. 1.

*Description.*—The zoarium incrusts shells. The zooecia are distinct, long, lageniform; the frontal is very convex, smooth, surrounded by very fine areolae. The apertura is deep, suborbicular, and formed of a large semilunar anter separated by two small cardelles from a very concave poster; the peristome bears six distal spines. The ovicell is smooth, globular, salient; it is hyperstomial, recumbent, opening largely in the peristomie; it is surrounded by a very little salient collar.

*Measurements.*—Apertura $\begin{cases} ha=0.13 \text{ mm.} \\ la=0.13 \text{ mm.} \end{cases}$ Zooecia $\begin{cases} Lz=0.65 \text{ mm.} \\ lz=0.30 \text{ mm.} \end{cases}$

*Affinities.*—This species presents all the characters which would permit its classification in *Lagenipora* Hincks, 1888. However, its ovicell is not placed as in *Lagenipora socialis* Hincks, 1877, and does not bear the cribriform area noted by Waters. On the other hand, the apertura with cardelles is a little different from the semielliptical apertura of the other species of *Perigastrella*. Finally the peristomiale is not free, which was a fundamental character according to Hincks. The generic place of this species is therefore doubtful.

It differs from *Perigastrella? costifera* of the same lageniform group in its zooecial size ($Lz$=0.65 and not 0.45 mm.) and in its smooth frontal.

*Occurrence.*—Upper Jacksonian (Ocala limestone): Chipola River, east of Marianna, Jackson County, Florida (common).

*Holotype.*—Cat. No. 64204, U.S.N.M.

### Genus HEMICYCLOPORA Norman, 1894.

1894. *Hemicyclopora* NORMAN, A Month on the Trondhjem Fiord, Annals and Magazine Natural History, ser. 6, vol. 13, p. 124.

The ovicell is recumbent. The apertura is provided with very low cardelles and formed of a large anter and of a small concave poster. The frontal is smooth and formed of an olocyst. Spines.

*Genotype.—Hemicyclopora* (*Lepralia*) *polita* Hincks, 1880.

*Range.*—Helvetian—Recent.

Another known recent species is *Hemicyclopora* (*Lepralia*) *labiosa* Jullien, 1903.

The only known fossil species is *Hemicyclopora obeliscus* Manzoni, 1875.

#### HEMICYCLOPORA PARAJUNCTA Canu and Bassler, 1917.

Plate 74, figs. 2, 3.

1917. *Hemicyclopora parajuncta* CANU and BASSLER, Synopsis of American Early Tertiary Cheilostome Bryozoa, Bulletin 96, United States National Museum, p. 69, pl. 6, fig. 6.

*Description.*—The zoarium incrusts shells. The zooecia are distinct, somewhat elongated, ogival; the frontal is somewhat convex and absolutely smooth. The apertura is oblique, suborbicular; the peristome bears 8 distal spines and a proximal small mucronoid lip. The ovicell is globular, very salient, smooth, very *little joined* to the distal zooecium; it is recumbent, hyperstomial.

*Measurements.*—Apertura $\begin{cases} ha=0.10 \text{ mm.} \\ la=0.09 \text{ mm.} \end{cases}$ Zooecia $\begin{cases} Lz=0.50\text{–}0.55 \text{ mm.} \\ lz=0.40\text{–}0.55 \text{ mm.} \end{cases}$

*Affinities.*—This species offers the exterior aspect of *Perigastrella* with very small areolae which generally appear smooth.

It differs from *Perigastrella depressa* in the presence of the small labial mucro and in its ovicell almost completely detached from the distal zooecium.

It differs from *Perigastrella trapezoidea* in the absence of areolae and in its much smaller ovicell more detached from the distal zooecium.

*Occurrence.*—Middle Jacksonian: Near Lenuds Ferry, South Carolina (common).

*Cotypes.*—Cat. No. 62610, U.S.N.M.

### Genus MASTIGOPHORA Hincks, 1880.

1880. *Mastigophora* HINCKS, British Marine Polyzoa, p. 278.

The ovicell is small and recumbent. The apertura is semilunar; its proximal border is straight and bears a rimule elongated and rounded. The frontal is a tremocyst with small pores placed on an olocyst. Vibracula.

*Genotype.—Mastigophora hyndmanni* Johnston, 1847, and *Mastigophora* (*Flustra*) *dutertrei* Savigny-Audouin, 1826. Lutetian—Recent.

The fossil species of this genus are:

*Pachyraspedoum zitteli* Koschinsky, 1885.

*Pachyraspedoum lautum* Koschinsky, 1885.

### MASTIGOPHORA HYNDMANNI Johnston, 1847.

Plate 74, fig. 10.

*Zoological bibliography.*

1847. *Lepralia hyndmanni* JOHNSTON, History of British Zoophytes, ed. 2. p. 306.
1848. *Herentia hyndmanni* GRAY, Catalogue British Museum, Animals, vol. 1, p. 122.
1852. *Lepralia hyndmanni* LANDSBOROUGH, History of British Zoophytes, p. 306.
1854. *Lepralia hyndmanni* BUSK, Catalogue Marine Polyzoa in British Museum, vol. 2, p. 74.
1868. *Lepralia hyndmanni* NORMAN, Shetland Final Dredging Rep't., 38th Meeting British Association, p. 307.
1873. *Hippothoa hyndmanni* SMITT, Floridan Bryozoa, 2, p. 41; Kongl. Svenska Vetenskaps-Akad. Handl., vol. 11, No. 4.
1880. *Mastigophora hyndmanni* HINCKS, British Marine Polyzoa, p. 281.
1889. *Mastigophora hyndmanni* JELLY, A Synonymic Catalogue of Marine Bryozoa, p. 141.
1903. *Mastigophora hyndmanni* JULLIEN and CALVET, Résultats des Campagnes scientifiques du Prince de Monaco, Fasc. 23, Bryozoaires provenant des campagnes de *l'Hirondelle* (1886–1888), pp. 91, 146.
1909. *Escharina hyndmanni* NORMAN, The Polyzoa of Madeira and Neighboring Islands, Journal Linnean Society Zoology, vol. 30, p. 302.
1911. *Mastigophora hyndmanni* MME. GUERIN-GANIVET, Bryozoaires des Côtes armoricaines, I, Travaux Scientifiques Laboratoire Zoologie de Concarneau, vol. 3, p. 6.

*Paleontological bibliography.*

1875. *Lepralia crassilabra* MANZONI, I Briozoi del pliocene antico di Castrocaro, p. 25, pl. 3, fig. 38.

1879. *Lepralia crassilabra* SEGUENZA, Le formazioni terziarie della Provincia di Reggio (Calabria), Reale Accademia Lincei, Mem. della Classe science Fisiche, Matemat. e Nat., pp. 81, 202.
1893. *Mastigophora hyndmanni* NEVIANI, Seconda cont. alla conoscenza Briozoi foss. italiani, Bolletino Società Geologia Italiana, vol. 12, p. 25.
1900. *Schizoporella hyndmanni* NEVIANI, Bryozoi Neozoici di alcune Localita d'Italia, pt. 6. Bolletino Società Zoologia Italia, p. 9 (66).
1900. *Schizoporella hyndmanni* NEVIANI, Briozoi fossili di Carrubare (Calabria), Bolletino Società Geologia Italiana, vol. 23, p. 532 (30).

The operculum always closes the ovicell. Among the specimens found in America, we have discovered a variation a little more elongated, which we have figured.

It is remarkable that this species which existed on both shores of the Atlantic at the end of the Eocene epoch no longer exists in America, even in the Gulf of Mexico.

*Occurrence.*—Lower Jacksonian: Jackson, Mississippi (rare).

Middle Jacksonian: 3½ miles south of Perry, Georgia (very rare).

Vicksburgian: West bank of Conecuh River, Escambia County, Alabama (very rare); 1 mile north of Monroeville, Alabama (rare).

*Geological distribution.*—Helvetian of Italy (Seguenza, Neviani) of Touraine (Canu); Zanclean of Italy (Seguenza); Plaisancian of Italy (Manzoni); Sicilian of Italy (Neviani).

*Habitat.*—Atlantic in British waters, 65–179 meters; in the British Channel; in the Gulf of Gascony, 166–250 meters; at the Azores, 120–130 meters; south of Africa. Mediterranean, along the French shores.

This is a deep-water species for it has never been dredged at less than a depth of 65 meters.

*Plesiotypes.*—Cat. No. 64207, U.S.N.M.

### MASTIGOPHORA DUTERTREI Savigny-Audouin, 1826.

Plate 74, fig. 11.

*Zoological bibliography.*

1809. *Flustra dutertrei* Savigny, Zoology Egypt, pl. 9, fig. 2.
1826. *Flustra dutertrei* Audouin, Explication des planches de M. Savigny, p. 67.

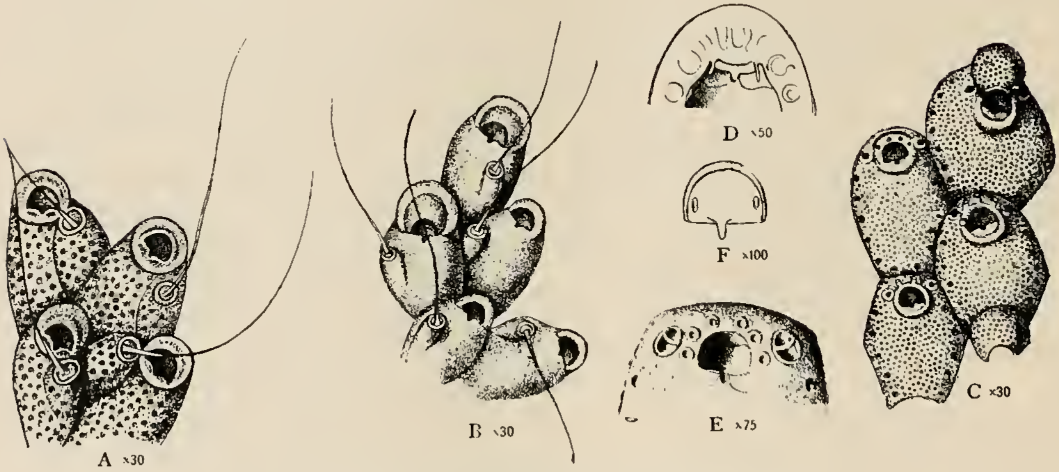

Fig. 175.—Genus *Mastigophora* Hincks. 1880.

A, B. *Mastigophora hyndmanni* Johnston, 1847. A. Zooecia with tremopores, × 30. B. Zooecia with ovicells, × 30.

C–F. *Mastigophora dutertrei* Audouin, 1826. C. Zooecia, × 30. (A–C after Hincks, 1880.) D. The distal end of a zooecium, × 50, from the basal aspect after the basal surface has been partly removed. The high hinge teeth are seen, and also the vestibular arch and the processes springing from the latter. E. View showing the vestibular arch and also the distal margin of the hinge teeth, which for the most part are internal, × 75. F. Operculum, × 100. (D–F after Levinsen, 1909.)

1852. *Reptescharellina dutertrei* D'Orbigny, Paleontologie Française. Terr. cretaces, vol. 5, p. 453.
1861. *Lepralia woodiana* Busk, New Polyzoa at Madeira, Quarterly Journal Microscopical Society, vol. 8, p. 284.
1862. *Lepralia woodiana* Hincks, Annals Magazine Natural History, ser. 3, vol. 9, sep. 2.
1868. *Lepralia woodiana* Peach, A New British Eschara, etc., Journal Royal Instit. Cornwall, vol. 18, sep. 2.
1880. *Mastigophora dutertrei* Hincks, British Marine Polyzoa, p. 279.
1885. *Mastigophora dutertrei* Waters, Cheilostomatous Bryozoa from Aldinga, etc. Quarterly Journal Geological Society London, vol. 41, p. 301.
1889. *Mastigophora dutertrei* Jelly, A Synonymic Catalogue of Marine Bryozoa, p. 141.

1890. *Mastigophora dutertrei* KIRKPATRICK, Report upon the Hydrozoa and Polyzoa collected by P. W. Bassett-Smith, during survey of the Tizard and Macclesfield banks, in the China Sea, Annals Magazine Natural History, ser. 6, vol. 5, p. 17.

1890. *Mastigophora dutertrei* ORTMANN, Die japanische Bryozoan-Fauna, Archiv für Naturg., vol. 50, pt. 1, p. 51, pl. 4, fig. 5.

1903. *Mastigophora dutertrei* JULLIEN and CALVET, Résultats des Campagnes sci. du Prince de Monaco, Fasc. 23, Bryozoaires provenant des campagnes de *l'Hirondelle*, pp. 91, 146.

1908. *Schizoporella dutertrei* WATERS, Report on the Marine Biology of the Sudanese Red Sea, Journal Linnean Society London, vol. 31, p. 128.

*Paleontological bibliography.*

1844. *Millepora punctata* PHILLIPI, Beiträge Kenntniss Tertiärversteinerungen des nordwestlichen Deutschlands, p. 67, pl. 1, fig. 13.

1859. *Lepralia woodiana* BUSK, A Monograph of the Fossil Polyzoa of the Crag, Publications Paleontographical Society London, p. 42, pl. 7, figs. 1, 3.

1865. *Lepralia aurita* REUSS, Ueber die Foramin., Anthozoen und Bryozoen des deutschen Septarienthones, Densch Akad. Wissensch., Wien, Abth, 1, p. 62, pl. 7, fig. 13.

1875. *Lepralia otophora* MANZONI (not Reuss), I Briozoi del pliocene antico di Castrocaro, p. 23, pl. 3, fig. 30.

1880. *Lepralia brachycephala* SEGUENZA, Le formazioni terziarie nelle Provincia di Reggio (Calabrai), Reale Acad. Lincei, Mem. Classe, Sci. Fisiche, Matema, e Naturali, pp. 82, 129.

1885. *Mastigophora dutertrei* WATERS, Cheilostomatous Bryozoa from Aldinga and the River Murray Cliffs, South Australia, Quarterly Journal Royal Microscopical Society, p. 301.

1898. *Schizoporella dutertrei* NEVIANI, Briozoi fossili della Farnesina e Monte Mario presso Roma, Paleontographica Italica, Piza, vol. 1, p. 113, sep. 37.

1898. *Schizoporella dutertrei* NEVIANI, Briozoi Neozoici di alcune località d'Italia, Bolletino Società Romana per gli Studi Zool., p. 14.

1900. *Schizoporella dutertrei* NEVIANI, Briozoi neogenici delle Calabrie, Paleontographia italica, vol. 6, p. 197 (83).

The geographical distribution of this species is considerable, but, like the preceding, it no longer exists on the American shore. However, at the end of the Eocene, it existed on the two sides of the North Atlantic. This phenomenon is inexplicable, all the more as the same genus is actually represented in the waters of Florida by two species. As in the preceding, we are quite certain that the ovicell is recumbent, placed on the distal part of the zooecium itself and that it does not rest on the distal zooecium.

*Occurrence.*—Upper Jacksonian (Ocala limestone): Alachua, Florida (very rare).

Vicksburgian ("Chimney rock" member of Marianna limestone): One mile north of Monroeville, Alabama (rare).

*Geological distribution.*—Rupelian and Chattian of Germany (Reuss); Helvetian of Italy (Seguenza); Tortonian of Italy (Seguenza); Plaisancian of England (Busk), of Italy (Manzoni); Sicilian of Italy (Neviani).

*Habitat.*—Pacific, off Japan, 163 meters, and off Chili, 44 meters. Atlantic; in British waters, 97–277 meters, at Madeira off the Azore Islands, 130 meters, and in the British Channel. Mediterranean, and the Red Sea.

*Plesiotype.*—Cat. No. 64208, U.S.N.M.

### Genus SCHIZOBATHYSELLA Canu and Bassler, 1917.

1917. *Schizobathysella* CANU and BASSLER, Synopsis of American Early Tertiary Cheilostome Bryozoa, Bulletin 96, United States National Museum, p. 69.

The apertura presents on its straight proximal border a small linear rimule. The ovicell is recumbent and opens widely above the apertura. The frontal is a tremocyst. The peristomie is greatly expanded and is interrupted in front by an immense incomplete spiramen. The avicularium is vibraculoid.

*Genotype.—Schizobathysella saccifera* Canu and Bassler, 1917. Jacksonian.

This genus differs from *Mastigophora* only in the nature of the peristome, which is much more salient and interrupted in front by a pseudo-spiramen.

It differs from *Gigantopora* Ridley, provided also with a spiramen, in the different form of the operculum, and in the smooth frontal of the latter.

To Jullien the spiramen seemed part of the hydrostatic apparatus. Here it appears to us as in rapport with the extrusion of the larvae.

#### SCHIZOBATHYSELLA SEMILUNATA, new species.

Plate 74, figs. 4–6.

*Description.*—The zoarium incrusts shells. The zooecia are elongated, distinct, swollen, elliptical; the frontal is very convex and formed of a tremocyst with numerous pores in quincunx. The peristome is thin, irregular, distally laciniate; the peristomie is long and recumbent on the distal zooecia; the apertura is semilunar; the anter is ogival and the poster straight; there are two small cardelles quite low. The spiramen is elliptical, transverse, much larger than the peristomice. A small, round avicularium near the spiramen.

*Measurements.*—Apertura $\left\{\begin{array}{l} ha=0.10\text{ mm.} \\ la=0.12\text{ mm.} \end{array}\right.$ Zooecia $\left\{\begin{array}{l} Lz=0.60\text{–}0.70\text{ mm.} \\ lz=0.30\text{–}0.40\text{ mm.} \end{array}\right.$

*Variations.*—The spiramen is not always complete; the transversal arch which separated it from the peristomice is not always formed, but the lateral walls of the peristomie are always salient. The appendages which ornament superiorly the peristome are analogous to those of *Galeopsis rabidus* Jullien, 1903. According to the French author these are the spines more or less united among themselves.

*Affinities.*—This species differs from *Galeopsis verrucosa* and *Galeopsis erinaceus* in the replacement of the frontal tuberosities by tremopores and in the semilunar and not elliptical form of the apertura.

*Occurrence.*—Middle Jacksonian: Wilmington, North Carolina (rare); 3½ miles north of Grovania, Georgia (very rare).

*Cotypes.*—Cat. No. 64205, U.S.N.M.

#### SCHIZOBATHYSELLA SACCIFERA Canu and Bassler, 1917.

Plate 74, figs. 7, 8.

1917. *Schizobathysella saccifera* CANU and BASSLER, Synopsis of American Early Tertiary Cheilostome Bryozoa, Bulletin 96, United States National Museum, p. 70, pl. 6, fig. 7.

*Description.*—The zoarium incrusts shells. The zooecia are distinct, elongated, irregularly elliptical; the frontal is convex and formed of a tremocyst with small pores. The apertura is semilunar; it bears on its straight proximal border a small linear rimule; the peristome is much developed into two large lateral lips circumscribing a sort of incomplete and very large spiramen. The ovicell is hyperstomial and recumbent; it forms a sort of small, punctured *sack* placed on the bottom of the zooecium. A small vibraculoid avicularium is developed laterally near the aperture.

*Measurements.*—Apertura $\left\{\begin{array}{l} ha=0.08 \text{ mm.} \\ la=0.10 \text{ mm.} \end{array}\right.$ Zooecia $\left\{\begin{array}{l} Lz=0.60\text{–}0.70 \text{ mm.} \\ lz=0.30\text{–}0.40 \text{ mm.} \end{array}\right.$

*Variations.*—The peristome is quite variable. The tremopores are often obliterated by fossilization. The ovicell is truly recumbent or partially supported on the distal zooecium (fig. 8). To accommodate so great a peristomial complexity it is probable that the tentacles were very long and fine.

*Occurrence.*—Middle Jacksonian: Wilmington, North Carolina (rare); one-half mile southeast of Georgia Kaolin Co. mine, Twiggs County, Georgia; 18 miles west of Wrightsville, Georgia.

*Cotypes.*—Cat. No. 62611, U.S.N.M.

### Genus LAGENIPORA Hincks, 1877.

1877. *Lagenipora* HINCKS, On British Polyzoa, Annals Magazine Natural History, ser. 4, vol. 20, p. 215.

"Colonies consisting of a number of cells immersed in a common calcareous crust. Zooecia recumbent, contiguous, lageniform; oral extremity free, tubular, with a terminal orbicular orifice." (Hincks.)

*Genotype.*—*Lagenipora socialis* Hincks, 1877.

*Range.*—Jacksonian—Recent.

Waters and Jullien did not admit that a long, free, peristomie could characterize a genus.

The first of these authors has preserved Hincks's name for all the species more or less erect and provided with a cribriform area on the ovicell. Levinsen, in 1909, called *Siniopelta* the group of the species of Waters in which the growth is that of the Cellepores.

We have not the data for a discussion, and we preserve Hincks's genus in his exact meaning. It is indisputable that the genotype is one of the Phylactellidae on account of the nature of its ovicell, and that the specimens discovered in our Eocene are well classified in this family.

#### LAGENIPORA AMERICANA, new species.

Plate 74, figs. 9.

*Description.*—The zoarium incrusts shells. The zooecia are distinct, long, lageniform, composed of two parts: the frontal is convex and garnished with tremopores; the peristomiale is very long, oblique, smooth, terminated by an expanded peristome. Ovicell unknown.

*Occurrence.*—Middle Jacksonian (Castle Hayne limestone): Wilmington, North Carolina (rare).

Upper Jacksonian (Ocala limestone): Old Factory, 1½ miles above Bainbridge, Georgia (very rare).

Vicksburgian ("Chimney rock" member of Marianna limestone): One mile north of Monroeville, Alabama (very rare).

*Holotype.*—Cat. No. 64206, U.S.N.M.

### Genus ASCOSIA Jullien, 1882.

1882. *Ascosia* JULLIEN, Dragages du *Travailleur*, Bryozoaires, Bulletin Société Zoologique de France, vol. 7, p. 9.

Zooecia erect joined together only at the base; orifice oval from the front backward, beveled on the top of the zooecia and looking forward, surrounded by a flat border; ovicell globular sunken in a hood on the back of the zooecia which bear it; one or two vibracula placed on the sides of the orifice. Dorsal face of the zoarium formed by the convex base of the zooecia which are separated by furrows.

*Genotype.*—*Ascosia pandora* Jullien, 1882. Recent.

### Genus TEMACHIA Jullien, 1882.

1882. *Temachia* JULLIEN, Dragages du *Travailleur*, Bryozoaires, Bulletin Société Zoologique France, vol. 7, p. 509.

The zooecia are suberect, dilated at the base, and narrowed like the neck of a bottle toward the top; the peristome is cleft anteriorly and deprived of spines; the ovicell is globular, and its opening corresponds to the cleft of the peristome. The ancestrula has a frontal wall entire and covered with lattice work, with two strong lateral spines at the level of the orifice. (Translation after Jullien.)

*Genotype.*—*Temachia opulenta* Jullien, 1882. Recent.

## Family CELLEPORIDAE Busk, 1852.

*Anatomical bibliography.*—1877. BARROIS, Recherches sur l'embryologie des Bryozoaires, Travaux de l'Institut de Zoologie, Lille, fasc. 1, pl. 8, figs. 34, 38, 39.—1888. JULLIEN, Mission scientific du Cap Horn, vol. 6, Zoologie, p. 63, pl. 1, fig. 4; pl. 13, figs. 1–4.—1900. CALVET, Contributions a l'histoire nat. des Bryozoaires ectoproctes marins, Travaux de l'Institut de Zool. de l'Universite de Montpellier Stat. marit. Catle, N. S., Memoire, No. 8, p. 6, fig. 12; pl. 13, fig. 16.—1904. WATERS, Bryozoa, Result. voyage Belgica, Zoology, p. 75.—1909. WATERS, Report on the Marine Biology of the Sudanese Red Sea, from collections made by Cyril Crossland, etc., XII, Journal Linnean Society London, vol. 31, pl. 14, fig. 13; pl. 16, figs. 7, 8.—1909. LEVINSEN, Morphological and Systematic Studies on the Cheilostomatous Bryozoa, p. 345.—1913. WATERS, Marine Fauna of British East Africa and Zanzibar, Proceedings Zoological Society London, p. 508.

The ovicell is recumbent. The budding is double, terminal and superficial. The zooecia are more or less erect and cumulate.

Figure 176 illustrates the anatomical knowledge of this important family.

The only known larva is of the schizostomatous group. Levinsen in 1909 created a special family for the holostomatous group, which is perhaps a valid one, but as we are ignorant of the larva we have not recognized it. Our clithridiate group is perhaps also a distinct family.

The budding is superficial; it occurs on all the zooecial walls. Certain frontal pores are therefore not areolae but veritable septules. The consequence is the piling up or accumulation of the zooecia. In the distal budding the zooecia are always oriented; in the superficial budding they are arranged in all directions. However, the zooecia issuing from the larva and those which are in contact with the substratum are always oriented. In some rare fossil species the cumulate zooecia are rare. The power of superficial budding is then apparently not spontaneous, but it is generalized gradually.

Among the Cheilostomes the Cellepores have appeared last (about the Lutetian) and in the tropical seas. They are multiplied to excess in the Miocene. At present they have overrun the seas, where often they multiplied in immense numbers; they dominate the recent fauna by their extraordinary numbers. In the size of their zoarium, the extreme rapidity of their budding, the infinite pliancy of their aptitude for adaptation, and in their astonishing fertility, they show an overwhelming vitality. They accommodate themselves to all areas, to all depths, to all temperatures, and to all kinds of foods. These are the most vigorous and the most perfected of all the bryozoa.

*Historical.*—An authoritative history of the genus *Cellepora* was given in 1852 by D'Orbigny.[1] He attributed it to Fabricius, 1780; this it appears was an error that Hincks repeated later; Levinsen, in 1909, noted that its founder was Linnaeus himself, in 1767. In 1913 Waters rewrote the history with a scrupulous exactitude; his conclusion was that the interpretation of the poor figures of the early authors has caused most vexatious confusion and that it is more scientific to adopt the types of Busk and Hincks, who recognized the true nature of the bryozoa.

It was in 1836 that Milne-Edwards, in the second edition of "Animaux sans vertebres" of Lamark, gave the name of Cellepores to the species with cumulate zooecia. Whether wrong or right, this opinion has prevailed in the science. There has been nothing of scientific interest added to the discussion after three-quarters of a century. Moreover, the word indicating only a special and complex mode of budding, ought necessarily to disappear from the generic nomenclature, since by definition even, a genus is a union of creatures having the same functions, the budding being only one of these functions.

We have preserved the word *Cellepora* as an invalid genus only for the species requiring further study, as we are often forced to do in paleontology.

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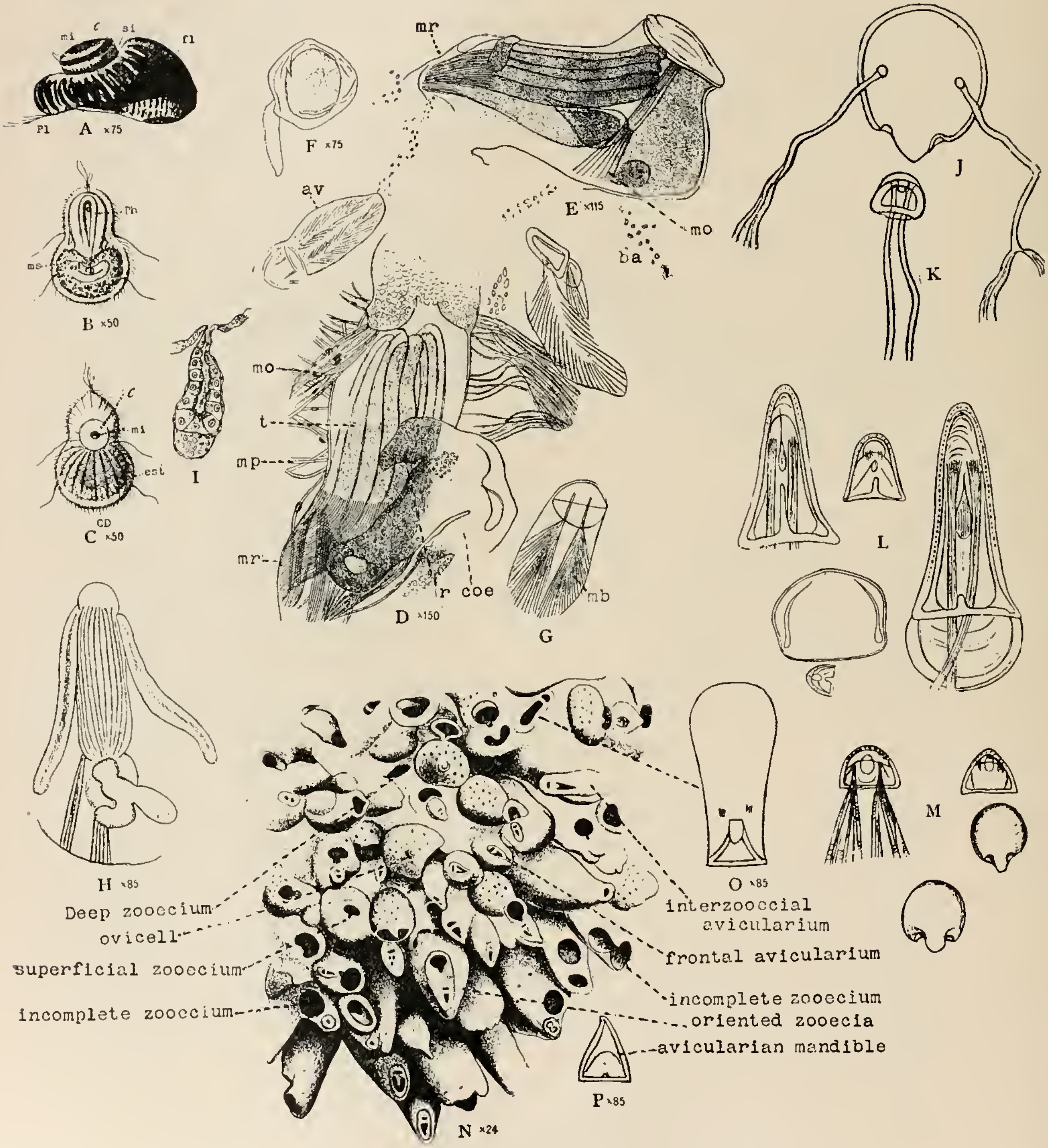
[1] Paleontologie française, Terrains Cretaces, p. 389.


mi
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est
CD
C ×50
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t
mp
mr
r
coe
D ×150
G
mb
L
H ×85
O ×85
M
Deep zooecium
ovicell
superficial zooecium
incomplete zooecium
interzooecial avicularium
frontal avicularium
incomplete zooecium
oriented zooecia
avicularian mandible
P ×85
N ×24

Fig. 176.—Anatomical structure of the family Celleporidae Busk, 1852.

FIG. 176.—Anatomical structure of the family Celleporidae Busk, 1852.

A–C. Free larva of *Schismopora pumicosa* Busk, 1854. A. Lateral view, × 75. showing the reduction of the calotte, the extension of the corona with the disappearance of the cilia replaced by a general covering of shorter cilia and, finally, the flattening of the oral face. B. View of the oral face showing the thick band of the oral mesoderm and in the middle a small portion of the stomach, × 50. C. View of the aboral face showing the aspect of the calotte and the epithelial structure of the stomach, × 50. (A–C after Barrois, 1877.) *c*, corona; *cd*, digestive cavity; *est*, stomach; *fl*, flagellum; *mi*, aboral mesoderm; *ms*, oral (labial) mesoderm; *o*, ciliated cleft; *ph*, pharynx; *pl*, vibratile plume; *si*, furrow of separation.

D–G. Anatomical structure of *Osthimosia evexa* Jullien, 1888. D. Zooecium viewed posteriorly. The funiculus seems to exist after the stomachic caecum, × 150. E. An isolated zooecium. The buds of the endocyst have developed to produce an avicularian cavity and to lodge in the areolar pores of the frontal face, × 115. F. A larva in its ovicell, after decalcification of the zoarium, × 75. G. Arrangement of the muscles in the avicularian cavity. (D–G after Jullien, 1888.) *av*, avicularium; *ba*, buds of the areolar pores; *coc*, stomachic caecum; *mb*, muscular bundles; *mo*, occlusor muscles of operculum; *mp*, parietal muscles; *mr*, large retractor muscles of the polypide; *r*, rectum; *t*, tentacles.

H. *Holoporella albirostris* Smitt, 1867. Polypide showing the long oral (vaginal) glands, × 85. (After Waters, 1913.)

I. *Schismopora pumicosa* Busk, 1854. Glandular vaginal organ (oral glands of Waters). Longitudinal section. (After Calvet, 1900.)

J, K. *Costazzia costata* MacGillivray, 1868. The muscles are attached to the operculum and the avicularian mandible. (After MacGillivray, 1888.)

L. *Holoporella apiculata* Busk, 1884. Chitinous appendages.

M. *Schismopora bidenticulata*, var. *subaequalis* Busk, 1884. Chitinous appendages. (L, M after Busk, 1884.)

N–P. *Schismopora coronopus* Wood, 1850. N. Portion of a zoarium, × 24, showing terminology. (After Jullien, 1903.) O. Mandible of the interzooecial avicularium, × 85. P. The avicularian mandible of the frontal avicularium, × 85. (O, P after Waters, 1885.)

*Terminology.*—The zooecia parallel to each other are called *oriented.* They are generally axial or marginal.

The nonparallel zooecia, erect in every meaning of the word, are the cumulate zooecia. Sections through such zoaria are very complicated and very difficult to comprehend.

The complete zooecia, the more exterior ones, are the superficial zooecia; they give the better characters for classification, but they are often broken on the fossils.

The deep zooecia separate the superficial zooecia, but at a lower level; their frontal is buried; their apertura and their avicularia are alone visible. Often their avicularia are more salient than those of the superficial zooecia because they endeavor to reach the level of the latter.

The zoarial surface is in perpetual growth; the formation of the zooecia is not simultaneous; there are therefore some incomplete zooecia. These are cavities of greater or less size, which must not be confused with the avicularia.

The interzooecial avicularia are very large. Their mandible is symmetrical and articulates on a pivot or on two lateral denticles. These avicularia bear some powerful muscles and they are adjacent to the superficial zooecia.

The frontal avicularia of the deep zooecia appear interzooecial when they are very salient; but they remain always attached to the deep zooecia, and they are completely isolated from the superficial zooecia.

Waters has best studied the classification of the Cellepores. In 1913 he gave a first grouping, which certainly will be perfected in the future. The table below sums up his opinion.

Schizostomatous division (=*Schismopora* MacGillivray, 1888):
  - *C. coronopus-pumicosa* group (*Cellepora* Waters, 1915; *Cellepora* Levinsen, 1909; *Osthimosia* Waters, 1913).
  - *C. eatonensis* group (*Osthimosia* Jullien, 1888; Waters, 1904, not 1913).
  - *C. costazzii* group (*Costazzia* Neviani, 1895; *Lagenipora* Waters, 1899; *Siniopelta* Levinsen, 1909).

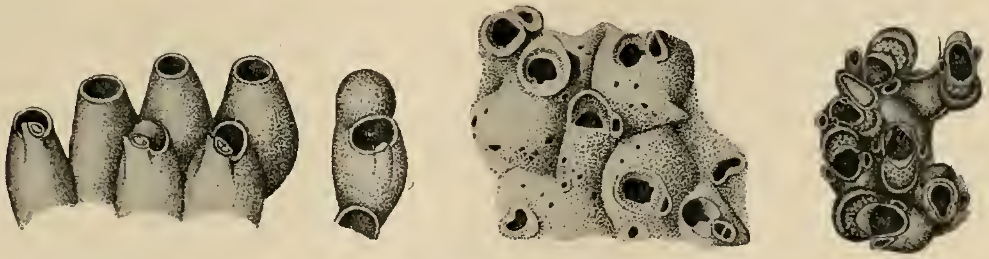
Holostomatous division (=*Holostoma*, MacGillivray, 1888):
  - *C. descostilsii* group (*Holoporella* Waters, 1905).
  - *C. sardonica* group.
  - *C. ramulosa* group.

To this we add a third division:

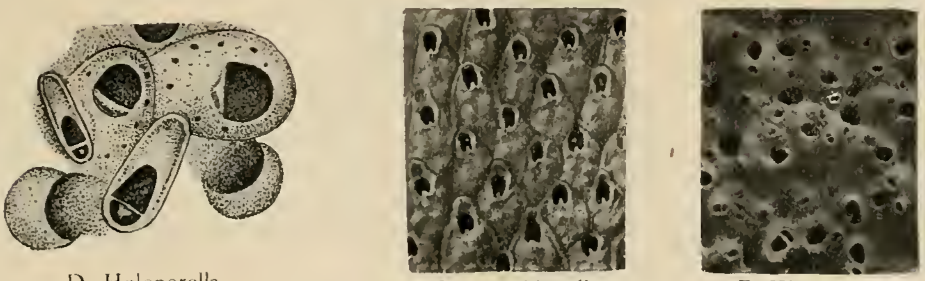
Clithridiate division:
  - *Acanthionella* Canu and Bassler, 1917.
  - *Kleidionella* Canu and Bassler, 1917.

We will adopt provisionally this classification and will discuss the names adopted for each genus. But the natural classification may only be made by the application of our system of physiological functions and in considering before all the connection of the operculum with the ovicell. It will be necessary to commence this work on the recent species.

The Cellepores are very difficult to study. Good specimens are rare, for the erect zooecia are very fragile and are easily broken. The technique of their study is quite difficult and still poorly established; the tangential sections are almost impossible; the obliquity of the apertura renders the interpretation of the interior difficult; the transverse sections give little information for their orientation is difficult. The illustration by photography is quite deceiving and by drawing it is very delicate. The preparation of the true illustration of a group of zooecia of Cellepores has not yet been realized.



A. Schismopora B. Osthimosia C. Costazzia



D. Holoporella E. Acanthionella F. Kleidionella

Fig. 177.—Genera of the family Celleporidae Busk, 1852.

A. *Schismopora pumicosa* Busk, 1894, × 30. Recent.
B. *Osthimosia evexa* Jullien, 1888, × 35. Recent.
C. *Costazzia costazzii* Savigny-Audouin, 1828, × 30. Recent.
D. *Holoporella descostilsii* Savigny-Audouin, 1828, × 25. Recent.
E. *Acanthionella oecioporosa*, new species, × 20. Claibornian of Alabama.
F. *Kleidionella grandis* Canu and Bassler, 1917, × 20. Jacksonian of North Carolina.

The recent specimens are more easily determinable; their chitinous appendages give excellent characters. Busk, MacGillivray, Waters, and Nordgaard have arranged excellent comparative tables; but they are still only of secondary importance to paleontologists.

We are studying at this moment different processes of technique which certainly will give us excellent results in the future but the essential condition is that our collectors should procure a large number of specimens in perfect preservation.

### Genus SCHISMOPORA MacGillivray, 1888.

1888. *Schismopora* MacGillivray, Bryozoa in McCoy's Prodromus of the Zoology of Victoria, vol. 2, dec. 17, p. 253.

The ovicell is perforated. The frontal is smooth. The apertura bears a proximal rimule. No spines. 15–20 tentacles.

*Genotypes.*—*Schismopora* (*Cellepora*) *coronopus* S. Wood, 1850, and *Schismopora* (*Cellepora*) *pumicosa* Busk, 1854.

*Range.*—Jacksonian—Recent.

*Historical.*—This is the Pumicosa group of Waters, for which he has always preserved the name of *Cellepora* until 1913, when certainly it was by error that he called it *Osthimosia.* The latter genus of Jullien is perfectly limited as he described it in 1904 and 1909. The genus *Schismopora* MacGillivray, 1888, has a much more general meaning, since he applied it to all the Cellepores with proximal rimule. We preserve it, however, with a more restricted meaning so as not to create a new name.

Certain recent species classified in this genus are provided with tremopores; it will be necessary to create a special genus for them.

#### SCHISMOPORA GLOBOSA, new species.

Plate 75, figs. 7–15.

*Description.*—The zoarium is massive, *globular*, measuring as much as 18 millimeters in diameter. The superficial zooecia are distinct, little erect, irregularly ovoid; the frontal is smooth and convex and bears an avicularium as large as the apertura. The apertura is oval and garnished with a wide triangular rimule. The deep zooecia are visible only through their apertura. The incomplete zooecia are rare. No interzooecial avicularium.

*Measurements.*—Apertura $\begin{cases} ha=0.15 \text{ mm.} \\ la=0.10 \text{ mm.} \end{cases}$

*Variations.*—The frontal avicularium is almost always broken; it leaves a wide cicatrix of little depth (fig. 11).

The transversal section (fig. 13) perfectly oriented is very instructive; it is the perfect type of the Celleporid accumulation. Above each zooecium there is a small triangular chamber which appears to correspond to the frontal avicularium; the plates of these small chambers unite two by two, outlining the zooecial contours. The skeletal tissue is an olocyst whose elements are scattered or piled together (fig. 14).

*Affinities.*—In its large zoarium and its frontal avicularium this species much resembles *Holoporella glomerata* Gabb and Horn, 1862. It differs from it in the different form of its apertura, in the absence of areolae, and its very little elevated zooecia.

*Occurrence.*—Lower Jacksonian (Moodys marl): Jackson, Mississippi (common).

*Cotypes.*—Cat. No. 64213, U.S.N.M.

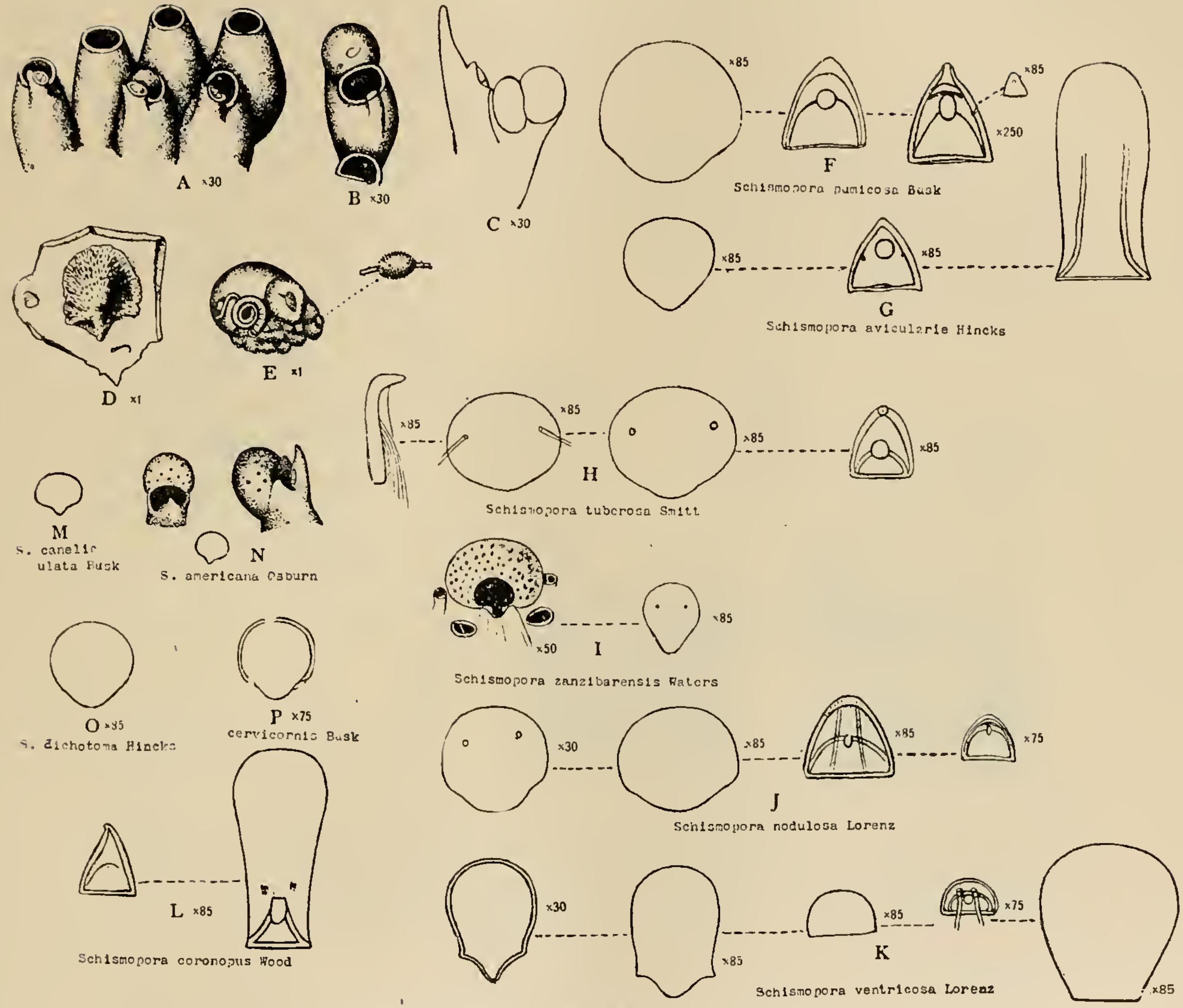

A ×30
B ×30
C ×30
×85
F
×85
×250
Schismopora pumicosa Busk
D ×1
E ×1
×85
×85
G
Schismopora avicularis Hincks
×85
×85
H
×85
×85
Schismopora tuberosa Smitt
M
S. canelic
ulata Busk
N
S. americana Osburn
×50
I
×85
Schismopora zanzibarensis Waters
O ×85
S. dichotoma Hincks
P ×75
cervicornis Busk
×30
×85
×85
×75
J
Schismopora nodulosa Lorenz
L ×85
Schismopora coronopus Wood
×30
×85
×85
×75
K
×85
Schismopora ventricosa Lorenz

FIG. 178.—Genus *Schismopora* MacGillivray, 1888.

A–F. *Schismopora pumicosa* Busk, 1854. A. Zooecia, × 30. B. Zooecium with ovicell, × 30. C. Side outline of zooecium, × 30. D, E. Zoaria, natural size. (A–E after Hincks, 1880.) F. Operculum and avicularian mandible. (After Nordgaard, 1903, and Waters, 1885.)

G–P. Opercula and avicularian mandibles. G. *Schismopora avicularis* Hincks, 1880. (After Waters, 1885, and Nordgaard, 1903.) H. *S. tuberosa* Smitt, 1867. (After Nordgaard, 1903.) I. *S. zanzibarensis* Waters, 1913. (After Waters, 1913.) J. *S. nodulosa* Lorenz, 1886. (After Nordgaard, 1905, and Lorenz, 1886.) K. *S. ventricosa* Lorenz, 1886. (After Nordgaard, 1905, and Lorenz, 1886.) L. *S. coronopus* Wood, 1850. (After Waters, 1885.) M. *S. canaliculata* Busk, 1884. (After Osburn, 1912.) N. *S. americana* Osburn, 1912. (M, N after Osburn, 1912.) O. *S. dichotoma* Hincks, 1880. (After Nordgaard, 1903.) P. *S. cervicornis* Busk, 1856. (After Lorenz, 1886.)

### SCHISMOPORA UMBONATA, new species.

Plate 75, figs. 1–3.

*Description.*—The zoarium is discoidal, convex, incrusting; the marginal zooecia are oriented; the central zooecia are heaped up. The superficial zooecia are erect, salient, very oblique, orbicular; the frontal is smooth and prolonged into a strong *umbo*, deforming or hiding the apertura. The apertura bears a wide, triangular, proximal rimule; it is little visible exteriorly. The deep zooecia are little visible and are revealed only by their apertura; they have no umbo. The marginal zooecia are oriented; their frontal is very convex and terminated by a large umbo completely hiding the apertura. The incomplete zooecia are rare.

*Measurements.*—Apertura $\begin{cases} ha=0.07 \text{ mm.} \\ la=0.06 \text{ mm.} \end{cases}$

*Affinities.*—In its large umbo and its oriented marginal zooecia this species resembles *Cellepora pumicosa* Busk, 1852. It differs from it in the absence of a visible avicularium on the umbo.

It differs from *Holoporella fissurata*, which is also surrounded by oriented zooecia, in a larger umbo, in smaller dimensions, and the absence of areolae.

*Occurrence.*—Upper Jacksonian (Ocala limestone): Alachua, Florida (very rare); West bank Sepulga River, Escambia County, Alabama (rare).

*Holotype.*—Cat. No. 64211, U.S.N.M.

### SCHISMOPORA ORBICULARIS, new species.

Plate 75, figs. 4–6.

*Description.*—The zoarium is unilamellar, little convex, incrusting algae, *orbicular*, garnished inferiorly with an epitheca smooth or slightly striated concentrically. The superficial zooecia are buried, distinct, elliptical, almost always oriented; the frontal is smooth and little convex; the apertura is oval, oblique with a wide triangular sinus, and often accompanied by a small avicularium. The ovicell reclines on the distal zooecia: its orifice is at the level of the proximal border of the peristomice. The deep zooecia have only their apertura visible.

*Measurements.*—Apertura $\begin{cases} ha=0.11\text{–}0.12 \text{ mm.} \\ la=0.10 \text{ mm.} \end{cases}$

*Affinities.*—The simplicity of structure of this species is remarkable. The cumulate zooecia are rare and are at the very center of the zoarium. The zoarium is manifestly orbicular and can attain 7 millimeters in diameter: unfortunately, we possess only the figured specimen.

This species differs from *Holoporella discus* in its very numerous oriented zooecia, in its apertura, which is smaller and of different form, and the absence of perforations on the basal epitheca.

In the determination of the Cellepores it is necessary to distrust the zoarial resemblances.

*Occurrence.*—Middle Jacksonian: One and one-half miles southeast of Georgia Kaolin Company Mine, Twiggs County, Georgia (very rare).

*Holotype.*—Cat. No. 64212, U.S.N.M.

### Genus OSTHIMOSIA Jullien, 1888.

1888. *Osthimosia* JULLIEN, Mission scientific du Cap Horn, vol. 6, Zoologie, p. 64.

The ovicell is not perforated. The frontal is surrounded by areolae. The apertura bears a proximal rimule. There are no spines.

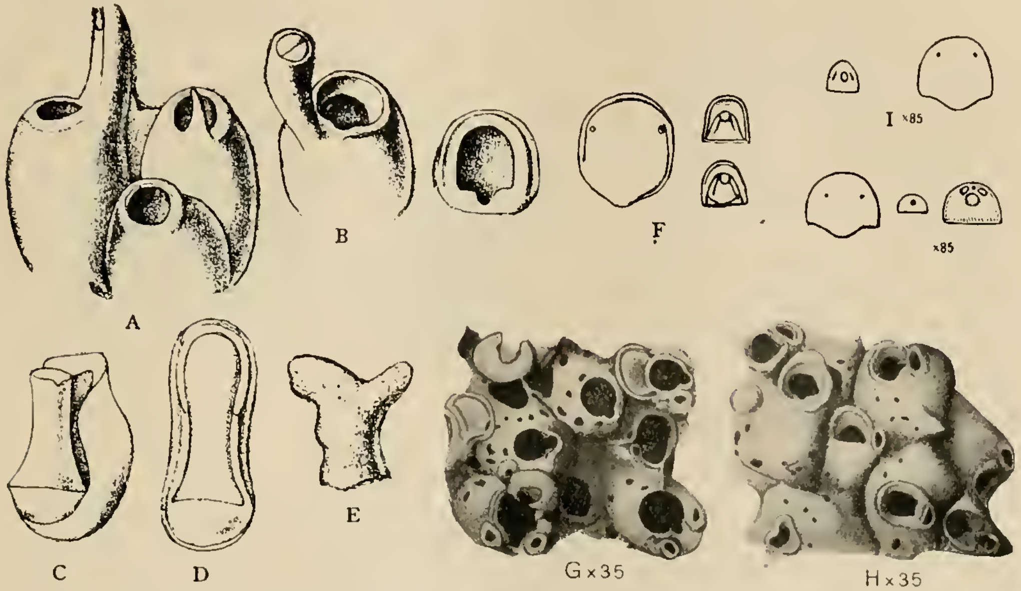


FIG. 179.—Genus *Osthimosia* Jullien, 1888.

A–F. *Osthimosia eatonensis* Busk, 1884. A. Zooecia seen in profile. B. Frontal view of zooecium. C, D. Two views of the interzooecial avicularium closed by the mandible. E. Zoarium natural size. F. Aperture, operculum, and avicularian mandible. (A–F after Busk, 1884.)

G. *Osthimosia otopeta* Jullien, 1888. Zooecia, × 35. (After Jullien.)

H, I. *Osthimosia evexa* Jullien, 1888. H. Zooecia, × 35. (After Jullien, 1888.) I. Operculum and avicularian mandible, × 85. (After Waters, 1904.)

J. *Osthimosia clavata* Waters, 1884. Operculum and avicularian mandibles, × 85. (After Waters, 1904.)

*Selected genotype.*—*Osthimosia* (*Cellepora*) *eatonensis* Busk, 1884. Jacksonian—Recent. The genotype of Jullien was *Osthimosia evexa* Jullien, 1888.

The recent species of this genus are:

*Osthimosia* (*Cellepora*) *eatonensis* Busk, 1884.
*Osthimosia otopeta* Jullien, 1888.
*Osthimosia clavata* Waters, 1884.
*Osthimosia* (*Cellepora*) *signata* Busk, 1884.
*Osthimosia evexa* Jullien, 1888.

*Osthimosia evexa* Jullien, 1888.

The known fossil species are:

*Osthimosia tubifera* Canu, 1908, Patagonian of Argentina.
*Osthimosia crassatina* Canu, 1908, Patagonian of Argentina.
*Osthimosia parvicella* Canu, 1908, Patagonian of Argentina.

### OSTHIMOSIA GLOMERATA Gabb and Horn, 1862.

Plate 74, figs. 12–19.

1862. *Celleporaria glomerata* Gabb and Horn, Monograph of the fossil Polyzoa of the Secondary and Tertiary formations of North America, Journal Academy of Natural Sciences, Philadelphia, ser. 2, vol. 5, p. 134, pl. 19, fig. 15.

*Description.*—The zoarium is massive, globular, measuring as much as 2½ centimeters in diameter. The superficial zooecia are scattered, distinct, oval, quite erect; the frontal is smooth and surrounded by some large areolar pores; it bears a median avicularium, with pivot, oval, with the point directed toward the base. The apertura is orbicular and is provided with a very wide and rounded rimule. The ovicell is large, smooth, transverse, recumbent; its orifice is very large and placed above the apertura. The deep zooecia have a reduced frontal; the apertura and the much enlarged avicularium are alone visible. The incomplete zooecia are quite numerous and irregular. There are some interzooecial avicularia, small and without pivot.

*Measurements.*—Apertura $\begin{cases} ha=0.10 \text{ mm.} \\ la=0.10 \text{ mm.} \end{cases}$

*Variations.*—The superficial zooecia are generally quite erect (figs. 15, 17, 19), but they are sometimes simply oblique (fig. 16). When the frontal avicularium is broken we have then the aspect of the figure given by Gabb and Horn. In reality the specimens of *Schismopora globosa* more often resemble this same figure. The American authors cite their specimen as from Vicksburg. In this locality we have only discovered the present species. We think, therefore, that our specimens really represent the species described by Gabb and Horn, from a specimen which appears, moreover, quite mediocre.

The considerable enlargement of the frontal avicularium in the deep zooecia is a useful phenomenon to note, for it occurs quite frequently.

Specimens of this species are often covered with incomplete zooecia, which do not allow serious determinations. Often, in fact, the zoarium of the Cellepores dies suddenly without apparent reason before the complete formation of the zooecia. In this species, as in all the massive or branched species, there are zooecia of all sizes and forms.

*Occurrence.*—Lower Jacksonian (Moodys marl): Jackson, Mississippi (very common).

Middle Jacksonian: Wilmington, North Carolina (common); 3¼ miles south of Perry, Georgia (rare).

Vicksburgian (Byram marl): Vicksburg, Mississippi (common).

*Plesiotypes.*—Cat. No. 64209, U.S.N.M.

### Genus COSTAZZIA Neviani, 1895.

1895. *Costazzia* NEVIANI, Briozoi neozoici di alcune localita d'Italia, Bolletino Societá Romana per gli Studi Zoologica, pt. 2, vol. 4, p. 235 (sep. 11); Synonyms *Lagenipora* WATERS, 1899–1913; *Siniopelta* LEVINSEN, 1909.

"The ovicell at the side of the peristome has a flat area and pores round the border" (Waters). "I zoeci, acervulati, hanno la frontal molto rigonfia, variamente perforata ed ornata da leggere costule; l'apertura zoeciale subtrigona con labbro calloso; grandi aviculari scafoidi sono sparsi fra i zoeci." (Neviani.) 14 tentacles.

*Genotype.*—*Costazzia* (*Cellepora*) *costazzii* Savigny-Audouin, 1826.

*Range.*—Vicksburgian—Recent.

*Historical.*—Waters, under the name of *Lagenipora*, and Levinsen, under the name of *Siniopelta*, designated an assemblage of identical forms appearing to constitute a rather natural genus. However, the type itself of *Lagenipora socialis* Hincks, 1880, is not comprised in the list given by Levinsen, and he himself classed it in *Schismopora*. Considering that the zooecia of *Lagenipora socialis* are oriented and by no means cumulate, we have maintained the genus of Hincks with its primitive definition in the family of Phylactellidae. For the genus *Siniopelta* Levinsen, 1909, we substituted the genus *Costazzia* Neviani, 1895, which has priority. Nevertheless, the definition given by the Italian author is incomplete and the acceptance of this genus is questionable. The frontal area of the ovicell does not correspond to a distinct function. Under our system of classification we can not admit this genus. Most of the species must be put in *Schizmopora*. The following species is described under *Costazzia* to call attention to this type of structure in American strata.

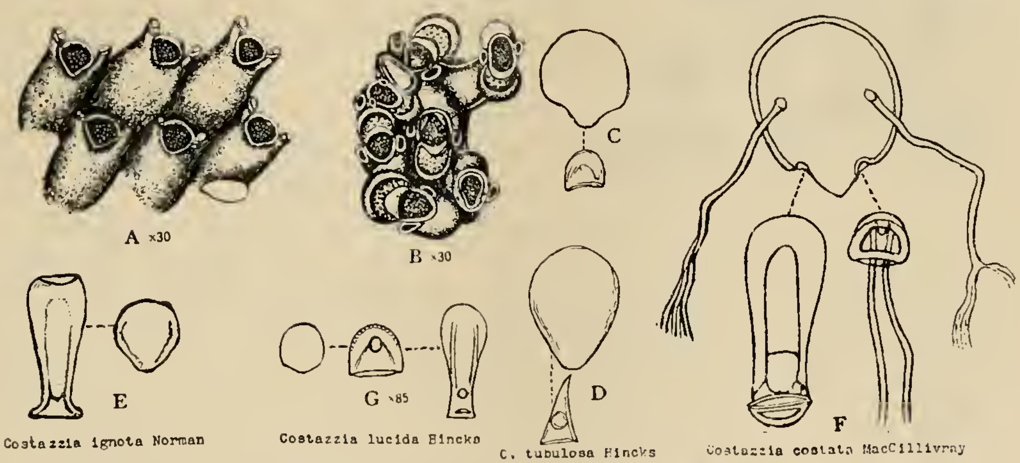


FIG. 180.—Genus *Costazzia* Neviani, 1895.

A–C. *Costazzia costazzii* Audouin, 1826. A, B. Ordinary zooecia and ovicells, × 30. (After Hincks, 1880.) C. Operculum and avicularian mandible. (After Busk, 1884.)

D–G. Opercula and avicularian mandibles. D. *Costazzia tubulosa* Hincks, 1880. (After Busk, 1884.) E. *C. ignota* Norman, 1909. (After Norman, 1909.) F. *C. costata* MacGillivray, 1868. (After MacGillivray, 1868, and Waters, 1885.) G. *C. lucida* Hincks, 1884. (After Waters, 1899.)

### COSTAZZIA ANTIQUA, new species.

Plate 100, fig. 22.

*Description.*—The only specimen found has been figured; its state of preservation is mediocre and does not permit of a serious study and a complete description. The zoarium is hollow and appears to incrust the radicells of an alga. The apertura is large and appears to have a large and wide proximal rimule. The ovicell is deeply imbedded in the distal zooecia, and probably may be always closed by the operculum; its area is large and fragile. There are small interzooecial avicularia provided with a pivot and a pointed beak.

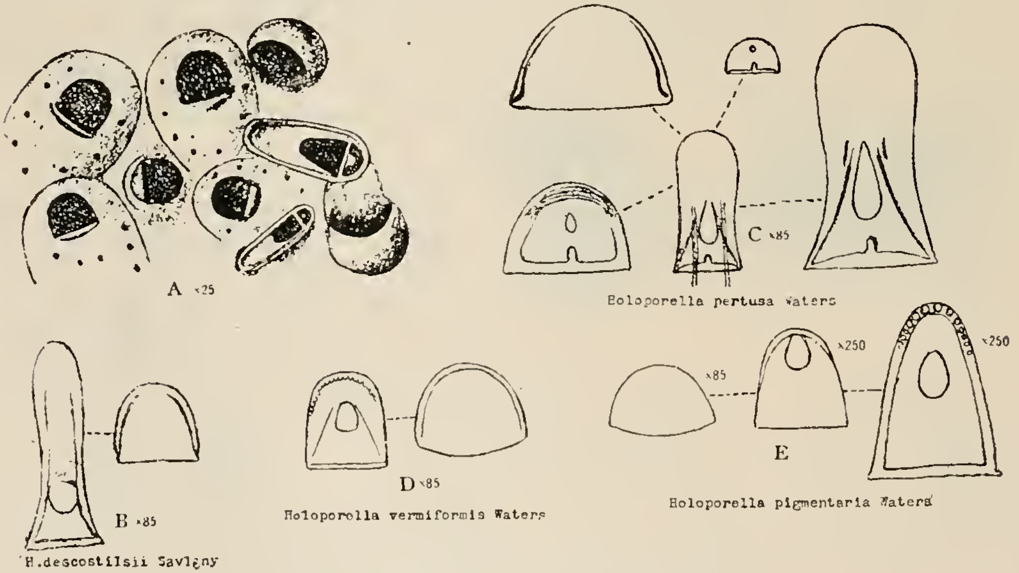

A ×25
C ×85
Holoporella pertusa Waters
×85
×250
×250
E
Holoporella pigmentaria Waters
B ×85
H.descostilsii Savigny
D ×85
Holoporella vermiformis Waters

Fig. 181.—Genus *Holoporella* Waters, 1909.

A, B. *Holoporella decostilsii* Savigny-Audouin, 1826. A. Zooecia, × 25. B. Operculum and avicularian mandible, × 85.

C–E. Opercula and mandibles. C. *Holoporella pertusa* Smitt, 1872. D. *H. vermiformis* Waters, 1909. E. *H. pigmentaria* Waters, 1909. (A–E after Waters, 1909.)

*Occurrence.*—Vicksburgian (Glendon member of Marianna limestone): West bank of Conecuh River, Escambia County, Alabama (very rare).

*Holotype.*—Cat. No. 64326, U.S.N.M.

### Genus HOLOPORELLA Waters, 1909.

1909. *Holoporella* Waters, Reports on the Marine Biology of the Sudanese Red Sea, etc., XII. The Bryozoa, Journal Linnean Society London, vol. 31, p. 159.

" The lower lip of the aperture is more or less straight; the operculum has the muscles attached near the border, sometimes with a ridge (for the attachment of the tentacular sheath) running inward. The ovicell is a widely open cap. There are usually oral and vicarious (interzooecial) avicularia, and the mandible of one of the two usually has a small projection from the base or columella" (Waters, 1909). Spines. 16–18 tentacles.

*Genotype.—Holoporella* (*Cellepora*) *descostilsii* Savigny-Audouin, 1826.

*Range.*—Claibornian—Recent.

### HOLOPORELLA ORBICULIFERA, new species.

Plate 16, figs. 10–15.

*Description.*—The zoarium is small, massive, convex, incrusting shells. The superficial zooecia are prominent, *orbicular*, separated; the frontal is smooth garnished with a very few areolae; it is terminated by a very fragile aviculiferous beak. The apertura is somewhat elongated, finely crenulated; the anter is semilunar and is separated from a concave poster by two small cardelles placed very low; the peristome is very thin and bears two large spines. The ovicell is recumbent, hyperstomial, transverse. The deep zooecia have a deep peristomie; they have neither spines nor avicularia. The incomplete zooecia are accompanied by a small elliptical or round avicularium with pivot.

*Measurements.*—Apertura $\begin{cases} ha = 0.09 \text{ mm.} \\ la = 0.06 \text{ mm.} \end{cases}$

*Variations.*—Usually the beak is broken and leaves a broad cicatrix on the frontal. The very small zoarium does not permit of good photography of the characters. The thin section shows some more or less large pores between the zooecia; they are irregular and do not appear to correspond to a definite organ. Some zooecia have a small, triangular upper chamber; this is the cavity of the aviculiferous beak (fig. 15). The walls are formed of scattered olocystal elements (fig. 14).

*Affinities.*—In the smallness of the zoarium and in its zooecial aspect this species approaches somewhat *Holoporella separata.* It differs from it in its imbedded zooecia without pedunculate avicularia.

*Occurrence.*—Claibornian (Gosport sand): Claiborne, Alabama (rare); 1 mile west of Rockville, Clarke County, Alabama (rare).

*Cotypes.*—Cat. No. 63859, U.S.N.M.

### HOLOPORELLA FISSURATA, new species.

Plate 76, figs. 4–6.

*Description.*—The zoarium forms small, convex masses on shells or on the radicells of algae; on oysters it is surrounded by a large zone of oriented zooecia. The superficial zooecia are salient, round, erect; the frontal is smooth, surrounded by four to seven large areolae; it is terminated by a pointed mucro deforming the apertura and bearing an oral avicularium, rather large and with a bar. The apertura is semilunar; the anter is large and the poster is concave; the peristome is very thin and very little salient and bears two large, symmetrical spines. The ovicell is salient, transverse, recumbent; it opens by a very large opening above the apertura; it bears a long arched *fissure*. The oriented zooecia are marginal; they are long, surrounded by areolae; the oral mucro bears no avicularia. The deep zooecia are visible only by their apertura. The incomplete zooecia are rare.

*Measurements.*—Apertura $\begin{cases} ha = 0.10\text{–}0.12 \text{ mm.} \\ la = 0.10\text{–}0.12 \text{ mm.} \end{cases}$

*Variations.*—This species is well characterized by its large, oral avicularium and by the fissure of its ovicell. The marginal zooecia exist only on the solid substratum (shells or bryozoa) (fig. 4). They evidently do not exist on the hollow tubular zoaria, which surround the radicells of algae. Likewise the incomplete zooecia exist only on the latter (fig. 5). In the interior the operculum articulates on two small condyles.

*Affinities.*—This species much resembles *Holoporella altirostris.* It differs from it in its larger apertura and in the absence of pedunculate avicularia on the deep zooecia.

It differs from *Holoporella albirostris* Smitt, 1872, of the waters of Florida, in the absence of the interzooecial avicularia, but it is very closely related.

*Occurrence.*—Lower Jacksonian (Moodys marl): Jackson, Mississippi (common).

Jacksonian (Zeuglodon zone): Shubuta, Mississippi (rare).

Vicksburgian (Marianna limestone): West bank of Conecuh River, Escambia County, Alabama (rare); Murder Creek, east of Castlebury, Conecuh County, Alabama (rare).

*Cotypes.*—Cat. Nos. 64216, 64217, U.S.N.M.

### HOLOPORELLA ALTIROSTRIS, new species.

Plate 75, figs. 16–20.

*Description.*—The zoarium forms small globular masses attached to other bryozoa, shells, or algae. The superficial zooecia are very salient, erect, irregular; the frontal is smooth and terminated by a *prominent beak*, bearing an enormous oral avicularium with pivot; the terminal portion of the beak is fringed and partially hides the apertura. The apertura is oblique, semilunar and formed of a large, finely crenulated anter, separated by two small cardelles placed very low from a concave poster; the peristome, thin and little salient, bears two symmetrical spines. The ovicell is recumbent, hyperstomial, transverse, smooth, globular, widely open above the apertura and at the level of the large oral avicularium; it bears in front either a small, fragile, cicatrix or a fissure. The deep zooecia have no frontal; their apertura is visible and the oral avicularium is quite salient and pedunculate. The incomplete zooecia are rare.

*Measurements.*—Apertura $\begin{cases} ha = 0.09 \text{ mm.} \\ la = 0.10 \text{ mm.} \end{cases}$

*Affinities.*—In its zoarium and in its ovicell, sometimes fissured, this species much resembles *Holoporella fissurata.* It differs from it in its much larger oral avicularium becoming pedunculate on the deep zooecia.

This fossil species bears the largest oral avicularium (0.18 by 0.15 mm).

*Occurrence.*—Middle Jacksonian: Wilmington, North Carolina (common); Rich Hill, Crawford County, Georgia (very common).

*Cotypes.*—Cat. Nos. 64214, 64215, U.S.N.M.

### **HOLOPORELLA GRANULOSA**, new species.

Plate 16, figs. 1–9.

*Description.*—The zoarium is massive and formed of small globular masses fixed to bryozoa or to shells, which it surrounds completely. The superficial zooecia are little erect, oblique, large, elliptical; the frontal is convex, surrounded by widely spaced areolae and formed of a *granular* pleurocyst placed on the olocyst. The apertura is large, semilunar, with a concave, proximal border; the peristome bears laterally one to two lateral avicularia. The ovicell is hyperstomial, recumbent, transverse, small, somewhat salient, granular, widely open above the apertura. The deep zooecia have a normal apertura and a very salient, peristomial avicularium. The incomplete zooecia are rare. The interzooecial avicularia are rather large, oval, little salient, without pivot.

*Measurements.*—Apertura $\begin{cases} ha = 0.15 \text{ mm.} \\ la = 0.17 \text{ mm.} \end{cases}$

*Variations.*—The zooecia in contact with the substratum (fig. 5) are oriented; on the lower face of the zoarium the zooecia are visible, irregular; their walls have two or three calcareous layers. The granular pleurocyst is detachable from the subjacent olocyst (fig. 8) and the two calcareous formations are often visible. In the interior (fig. 6) the apertura is oblique and without cardelles. The ovicell is of the same nature as the frontal (fig. 4). The interzooecial avicularia (figs. 3, 7) are quite remarkable in the absence of pivot.

*Affinities.*—By its zooecial aspect this species much resembles *Holoporella descostilsii* Savigny-Audouin, 1826, of recent seas. It differs simply in the presence of peristomial avicularia.

*Occurrence.*—Claibornian (Gosport sand): Claiborne, Alabama (rare); Gopher Hill, Tombigbee River, Alabama (rare); 1 mile southwest of Rockville, Clarke County, Alabama (very common).

Claibornian (Cook Mountain formation): Moseleys Ferry, Caldwell County, Texas (rare).

Claibornian (Lisbon formation): Wautubbee Hill, Clarke County, Mississippi (very common).

Lower Jacksonian (Moodys marl): Jackson, Mississippi (common).

*Cotypes.*—Cat. No. 63858, U.S.N.M.

### **HOLOPORELLA CRASSICOLLIS**, new species.

Plate 76, figs. 11, 12.

*Description.*—The zoarium is unilamellar and incrusts shells. The zooecia are little erect, almost always oriented; the frontal is smooth and convex. The apertura is small, elongated, and formed of a large circular anter separated by two small triangular cardelles from an almost straight poster; the peristome is very *thick*, salient; it bounds an infundibuliform peristomie and bears eight spines. The ovicell is hyperstomial, recumbent, very small, little salient, smooth; it is widely open in the peristomie. Laterally and near the apertura there is a small, oblique, little salient avicularium.

*Measurements.*—Apertura $\left\{\begin{array}{l} ha=0.15 \text{ mm.} \\ la=0.10 \text{ mm.} \end{array}\right.$

*Occurrence.*—Middle Jacksonian: Wilmington, North Carolina (rare); Rich Hill, Crawford County, Georgia (rare).

*Holotype.*—Cat. No. 64219, U.S.N.M.

### HOLOPORELLA PISIFORMIS, new species

Plate 77, figs. 8–11.

*Description.*—The zoarium is formed of small, globular masses, of the size of a *pea*. The superficial zooecia are small, raised, and entirely smooth. The apertura is semilunar and provided with two large cardelles; the peristomice is very irregular; its proximal edge bears two lips more or less coalescent and sometimes a small oral, elliptical avicularium. The ovicell is hyperstomial, recumbent, globular, smooth, widely open above the apertura. The deep zooecia are visible only by their apertura.

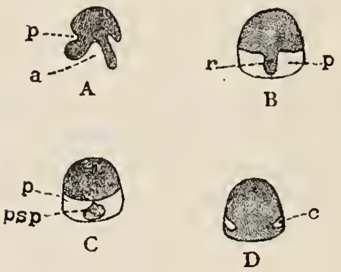


FIG. 182.—*Holoporella pisiformis*, new species.

A–C. Sketches showing variations in the form of the peristomice. D. Sketch of apertura. *a*, mucro; *c*, cardelles; *p*, lateral apophysis; *psp*, pseudospiramen; *r*, rimule.

*Measurements.*—Apertura $\begin{array}{l} ha=0.08 \text{ mm.} \\ la=0.07 \text{ mm.} \end{array}$

*Variations.*—This small species is remarkable in the disconcerting irregularity of its peristomice hiding the apertura. Certain zooecia have a salient mucro (fig. 11); then the two cardelles are replaced by two peristomial apophyses separated from the mucro by two pseudorimules. Other zooecia bear two apophyses separated by a rimule (fig. 9); the latter may be joined (fig. 10), surrounding thus a sort of spiramen. All these details have the most minute dimensions.

*Affinities.*—This species is well characterized by its small dimensions and its peristomial variations. It differs from *Holoporella separata* in its smaller zooecia and in the absence of pedunculate avicularia issuing from the deep zooecia.

It differs from *Holoporella micropora* with small zooecial dimensions, in its more elevated zooecia, its smaller zoarium and in its much larger apertura ($ha=$ 0.08 and not 0.05 mm.).

*Occurrence.*—Middle Jacksonian: Wilmington, North Carolina (common); Rich Hill, Crawford County, Georgia (rare).

*Cotypes.*—Cat. No. 64223, U.S.N.M.

### HOLOPORELLA DAMICORNIS, new species.

Plate 77, figs. 1–7.

*Description.*—The zoarium incrusts, first, the radicels of an alga to form an attachment for suspension; it then develops freely into a small irregular mass ornamented with *horns* of greater or less length. The superficial zooecia are little erect, simply oblique; the frontal is smooth and quite convex; it is terminated by an aviculiferous umbo more or less developed; the avicularium is open under the umbo toward the apertura. The apertura is semilunar, very finely crenulated; the anter is separated from the poster, which is smaller and concave, by two minute cardelles. The ovicell is hyperstomial, very salient, globular, smooth, provided with a large opening. The deep zöoecia are rare; they have no frontal; their umbo forms an interzooecial prominence. The interzooecial avicularia are large, elliptical, with pivot. The incomplete zooecia are suborbicular and not rare.

*Measurements.*—Apertura $\begin{cases} ha=0.15 \text{ mm.} \\ la=0.13 \text{ mm.} \end{cases}$

*Variations.*—The zoarium with its eccentric shape is very curious; no one specimen resembles another and yet all have a general indefinable facies which permits their immediate determination. Evidently this is not altogether a phenomenon of symbiosis in its entirety, but it is very close to it. It is even probable that the alga chosen by the larva was always the same and that its disappearance has caused at the same time the death of the Cellepore.

The umbo is rather fragile and is easily broken (fig. 6); often it is even not developed at all (fig. 5).

Figure 7 shows the ordinary cumulation of the zooecia. Such sections indicate the complicated structure of the zooecial walls, which sometimes appear to contain dictellae. The interpretation of the sections of the Cellepores are really problems of descriptive geometry.

*Affinities.*—In its zooecia this species somewhat resembles *Holoporella albirostris* Smitt, 1872, which still lives in the Floridan waters. It differs from it however in its symmetrical umbo and the absence of areolae.

*Occurrence.*—Jacksonian (Zeuglodon zone): Suck Creek, Clarke County, Mississippi (rare); Cocoa post office, Choctaw County, Alabama (common); Jackson, Mississippi (very rare).

*Cotypes.*—Cat. No. 64222, U.S.N.M.

### HOLOPORELLA SEPARATA, new species.

Plate 76, figs. 13–19.

*Description.*—The zoarium is massive and is formed of small irregular masses fixed to bryozoa, to the convexity of shells, or to the radicells of algae. The superficial zooecia are erect, suborbicular, *separated* one from the other; the frontal is smooth. The apertura is orbicular and formed of a large, semilunar anter separated from a convex poster by two small cardelles. On the frontal is an oval avicularium with pivot and pointed beak and placed obliquely with respect to the apertura. The ovicell is hyperstomial, salient, globular, smooth. The deep zooecia have an analogous apertura and an oral pedunculate avicularium quite salient, just to the level of the superficial zooecia. The incomplete zooecia are abundant; they are formed either by simple cavities or by zooecia deprived of frontal.

*Measurements.*—Apertura $\begin{cases} ha=0.06 \text{ mm.} \\ la=0.06 \text{ mm.} \end{cases}$

*Affinities.*—This species resembles absolutely *Holoporella altirostris* in all its general characters. It differs from it only in its smaller micrometric dimensions, the smaller oral avicularium, and the absence of the two spines of the peristome. It appears like a minor variety. The true difference is in the appearance of the zoarium which particularly affects the convexity of shells.

*Occurrence.*—Middle Jacksonian: Baldock, Barnwell County, South Carolina (very common); one-half mile southeast of Georgia Kaolin Co. mine, Twiggs County, Georgia (rare); 3½ miles north of Grovania, Georgia (rare).

Jacksonian (Zeuglodon zone): Shubuta, Mississippi (rare).

*Cotypes.*—Cat. No. 64220, U.S.N.M.

### HOLOPORELLA MICROPORA, new species.

Plate 76, figs. 7–10.

*Description.*—The zoarium is free, massive, and globular. The superficial zooecia are small, little erect, simple, oblique; the frontal is smooth and convex; it is terminated by an aviculiferous salient beak. The apertura is quite *small* and semilunar; two small cardelles separate the concave poster from a larger anter. The deep zooecia have their umbo completely developed. The interzooecial avicularia are rather large, elliptical, rare.

*Measurements.*—Apertura $\begin{cases} ha=0.04 \text{ mm.} \\ la=0.06 \text{ mm.} \end{cases}$

*Affinities.*—This species is characterized by the extreme smallness of its apertura. It differs from *Holoporella pisiformis* in its larger zoarium, which may attain 1½ cm. in diameter, in its oblique and not erect zooecia, and in its still smaller apertura.

*Occurrence.*—Upper Jacksonian (Ocala limestone): Below Plant System Railroad wharf, Bainbridge, Georgia (very rare); Old Factory, 1½ miles above Bainbridge, Georgia (common).

*Cotypes.*—Cat. No. 64218, U.S.N.M.

### HOLOPORELLA SEPOSITA, new species.

Plate 102, figs. 7–9.

*Description.*—The zoarium is free, massive, globular, and of the size of a pea or fastened on the bryozoa in small, very convex masses. The superficial zooecia are completely erect, orbicular, quite *scattered* from each other; the frontal is smooth and surrounded by from 4 to 6 large, widely spaced areolae. The apertura is ogival very finely crenulated with two minute cardelles placed quite low; the peristome is funnel shaped and bears four spines. The ovicell is hyperstomial, recumbent, salient, transverse, smooth; it opens very widely above the apertura. Very often the frontal bears a submedian triangular avicularium, with pivot. The deep zooecia are almost entirely visible. The incomplete zooecia and the oral, incomplete avicularia are very abundant.

*Measurements.*—Apertura $\left\{\begin{array}{l} ha=0.09 \text{ mm.} \\ la=0.08 \text{ mm.} \end{array}\right.$

*Variations.*—It is quite rare that a zoarium dies when its superficial zooecia are completely formed (fig. 9). The most habitual aspect is that of figure 8; the oral avicularium is reduced to the state of a cicatrix of more or less depth: the spines are almost always absent and the incomplete zooecia are very abundant. The Cellepores are not always marred by fossilization; they are often incompletely developed.

*Affinities.*—This species differs from *Holoporella orbiculifera* in its larger and more scattered zooecia and in having four spines instead of two.

It differs from *Holoporella pisiformis* in its larger micrometric dimensions and in the absence of a peristomice with simple or double apophysis.

It differs from *Holoporella separata* in the absence of a large pedunculate avicularium between the superficial zooecia and in the presence of four spines and some areolae.

*Occurrence.*—Vicksburgian (Marianna limestone): West bank Conecuh River, Escambia County, Alabama (common); Murder Creek, east of Castlebury, Conecuh County, Alabama (rare); near Claiborne, Monroe County, Alabama (rare); Salt Mountain, 5 miles south of Jackson, Alabama (common).

*Cotypes.*—Cat. No. 64329, U.S.N.M.

### HOLOPORELLA PERISTOMARIA, new species.

Plate 102, figs. 5, 6.

*Description.*—The zoarium is a small, irregular mass. The superficial zooecia are erect, tubular; the frontal is convex, surrounded by some large areolae. The apertura is oval, the poster being very concave; it is surrounded by a very long *peristomie*, sometimes fissured in front; the peristome is more or less thick, according to its proximity of the apertura. The deep zooecia have a small avicularium on their peristome. The marginal zooecia are recumbent, somewhat elongated, very convex; their frontal is terminated by an aviculiferous beak, salient and not symmetrical.

*Measurements.*—Apertura $\left\{\begin{array}{l} ha=0.07 \text{ mm.} \\ la=0.06 \text{ mm.} \end{array}\right.$

*Affinities.*—The only specimen collected has been figured; although it bears no ovicell, it appears to us to be sufficiently characterized to be described. Manifestly the frontal is formed of a pleurocyst with extremely fine granules superposed on the olocyst. The considerable development, attaining 0.15 mm. in length, of the peristomie is very characteristic; it seems to us that it was uniquely of pleurocystal origin.

*Occurrence.*—Vicksburgian (Byram marl): Byram, Mississippi (very rare).

*Holotype.*—Cat. No. 64328, U.S.N.M.

### HOLOPORELLA DISCUS, new species.

Plate 102, figs. 10–13.

*Description.*—The zoarium is free and *discoidal*, of 8 millimeters in diameter at the most. On the lower face the zooecia are oriented, irregularly hexagonal, perforated by a small submedian pore (corresponding perhaps to the radicles). The superficial zooecia are erect or quite oblique, distant from one another; the frontal is convex and granular, surrounded by seven or eight widely spaced areolar pores. The apertura is formed of an anter almost circular and of a small, somewhat concave poster, separated by two very small cardelles; the peristome is wide crenulated; it limits an infundibuliform peristomie. The deep zooecia are deprived of frontal. The incomplete zooecia are large and rare.

*Measurements.*—Apertura $\begin{cases} ha=0.11 \text{ mm.} \\ la=0.13 \text{ mm.} \end{cases}$

*Variations.*—We have supposed that the pores of the inner face are the radicles which permit the zoarium to attach itself to stones or shells. The larva is fastened on a minute fragment of bryozoa or shells and never on a large surface. The absence of vibracula, that is to say, of all system of stabilization, does not allow us to believe that the zoarium could attach itself to the algae or float freely below their fronds in the manner of the Lunulites.

*Affinities.*—The affinities of this species are chiefly with *Holoporella crassicollis*, in which the peristomie is also infundibuliform and the dimensions very close. *Holoporella discus* differs from it in the presence of areolae, in the absence of multiple spines, and in its free, discoidal, nonincrusting zoarium.

It differs from *Schismopora orbiculata*, in which the zoarium is also discoidal, in the form of its apertura deprived of rimule, in its very erect zooecia and in the presence of perforations on the lower face.

*Occurrence.*—Vicksburgian ("Chimney rock' member of Marianna limestone): One mile north of Monroeville, Alabama (very common).

*Cotypes.*—Cat. No. 64330, U.S.N.M.

### HOLOPORELLA BIROSTRATA, new species.

Plate 76, figs. 20–24.

*Description.*—The zoarium forms a small convex mass, incrusting stones. The superficial zooecia are erect and salient; the frontal is convex, smooth, and bears two or three small salient avicularia, with pivot; it is prolonged into a *bifid beak*, which partially masks the apertura. The ovicell is hyperstomial, recumbent, salient, globular, transverse, smooth. The deep zooecia are entirely hidden; their apertura is alone visible. The submarginal zooecia are oblique, oriented; the frontal is very convex, smooth, and terminated by a double beak, of which one at least is aviculiferous; there are three small elliptical avicularia with pivot on the frontal; the oral avicularium is curved and opens into the locella. The marginal zooecia are oriented; the frontal is terminated by two aviculiferous beaks entirely hiding the apertura; there is only one avicularium in the vicinity of the apertura; the apertura is very oblique, and disposed at the base of the locella. The interzooecial avicularia are elongated like the beak of a duck; the pivot separates a small pore in crossing the subtriangular orifice; the mandible was lodged in two-thirds of a calcified area.

*Affinities.*—In the interior on the apertura there are two small cardelles separating a large anter from a smaller, very concave and broader poster (fig. 24). The apertura is very finely denticulated.

Some zooecia are perforated in their median portion by a longitudinal tube, the external relations of which have not been discovered because of the lack of specimens.

The marginal zooecia much resemble the *Cellepora verrucosa* Reuss, 1847. The present species differs from it in the presence of two oral avicularia opening into the locella.

*Occurrence.*—Middle Jacksonian (Castle Hayne limestone): Wilmington, North Carolina (very rare).

*Cotypes.*—Cat. No. 64221, U.S.N.M.

ANALYTICAL KEY TO HOLOPORELLA.

| | | |
|---|---|---|
| 1 | The frontal is bordered with areolae | 2. |
| | The frontal is entirely smooth (new genus) | 3. |
| 2 | Zoarium discoidal | *H. discus.* |
| | Ovicell fissured | *H. fissurata.* |
| | Two or three salient avicularia on frontal | *H. birostrata.* |
| | Long peristomie | *H. peristomaria.* |
| | Spines. Oral avicularium on the frontal | *H. seposita.* |
| | No spines. Oral avicularium disposed laterally on the peristome | *H. granulosa.* |
| 3 | No oral avicularium or aviculiferous beak on the frontal | *H. crassicollis.* |
| | Avicularium or beak | 4. |
| 4 | No large interzooecial avicularia | 6. |
| | Large interzooecial avicularia | 5. |
| 5 | Zoarium massive, very small zooecia | *H. micropora.* |
| | Zoarium large and with hornlike processes; large aviculiferous umbo | *H. damicornis.* |
| 6 | Avicularium of more than 0.20 mm. in length | *H. altirostris.* |
| | Avicularium of less than 0.20 mm. in length | 7. |
| 7 | Pedunculated avicularium between the superficial zooecia | *H. separata.* |
| | No salient avicularium | 8. |
| 8 | Spines. Zoarium free | *H. separata.* |
| | No spines. Zoarium incrusting | *H. orbiculifera.* |

According to the nature of the frontal there are really two distinct genera. We have not formed them, because on the fossils not only are the areolae not always visible, but also they are often closed. Moreover, our technique was too elementary.

### CLITHRIDIATE GROUP.

The orifice is oval. The frontal is a very thick olocyst perforated by some scattered avicularia. The ovicell is hyperstomial and lodged in the thickening of the olocyst.

It would be convenient, perhaps, to make a special family for this group; but we are ignorant of the larva, and it is necessary to search first and find the analogous or closely related recent species.

Some species have very little of cumulate zooecia.

### Genus ACANTHIONELLA Canu and Bassler, 1917.

1917. *Acanthionella* Canu and Bassler, Synopsis of American Early Tertiary Cheilostome Bryozoa, Bulletin 96, United States National Museum, p. 72.

The apertura is oval and bears a long lyrula. The frontal is a very thick olocyst, in which are lodged some avicularia. The ovicell is hyperstomial; it is lodged in the thickening of the frontal of the distal zooecia; it opens into the peristomie.

*Genotype.*—*Acanthionella* (*Escharifora*) *typica* Gabb and Horn, 1862.

*Range.*—Maastrichtian—Jacksonian.

This genus differs from *Kleidionella* in the presence of a lyrula and the rarity of cumulate zooecia.

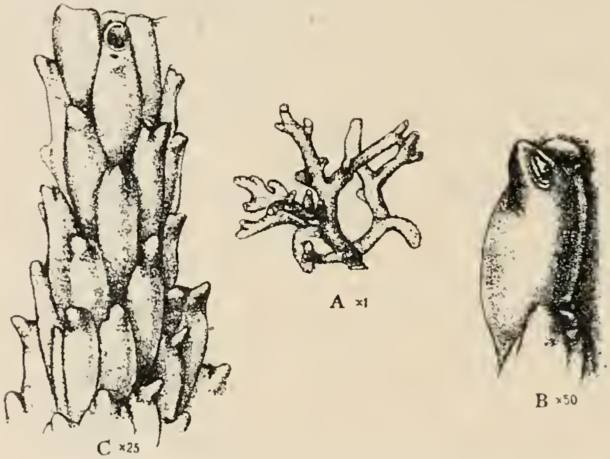


Fig. 183.—*Cellepora ramulosa* Busk, 1854.
A. Zoarium, natural size. B. Zooecium, × 50. C. Portion of zoarium, × 25. (A-C after Busk, 1854.)

### ACANTHIONELLA OECIOPOROSA, new species.

Plate 17, figs. 1–14.

*Description.*—The zoarium is free, bilamellar, with fronds more or less rounded. The oriented zooecia are indistinct; the frontal is a very thick olocyst perforated by two to five small avicularia. The apertura (interior) is oval and garnished by a long proximal lyrula; the peristomice (exterior) is orbicular; the peristomie is very deep and contains sometimes an avicularium bearing the lyrula. The ovicell is buried in the distal zooecia; it opens into the peristomie; it bears a frontal area closed by a much branched spine. The young zooecia and the cumulate zooecia are distinct, elongated, gibbose. The interzooecial avicularia are rare, of the size of the zooecia, elliptical, and provided with a pivot.

*Measurements.*—Apertura (interior) $\begin{cases} ha=0.10 \text{ mm.} \\ la=0.14 \text{ mm.} \end{cases}$ Zooecia (interior) $\begin{cases} Lz=0.35 \text{ mm.} \\ lz=0.26 \text{ mm.} \end{cases}$

*Variations.*—Most of the time the zooecia are oriented; nevertheless the species is quite variable. The young zooecia (fig. 7) and the cumulate zooecia (fig. 10) on the same zoarium (fig. 6) have a thin and gibbose frontal wall. These gibbosities are much smaller on the zooecia with thick frontal (fig. 2) and are placed between the avicularia. We have nothing to prove that the perforations of the frontal are really avicularia and contain neither denticle nor pivot; but on the genotype there are some true avicularia with pivot. The peristomial avicularium is very curious: it is placed obliquely (fig. 5) and is little visible exteriorly; it bears the habitual lyrula. The porous area of the ovicell is of a unique type; it is formed by a much branched spine forming a sort of filtering apparatus and breaking very easily (fig. 4).

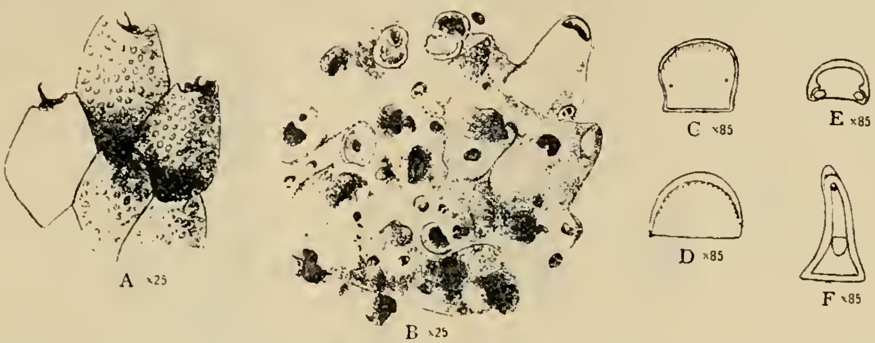


Fig. 184.—*Cellepora sardonica* Waters, 1879.

A. Oriented zooecia, × 25. B. Cumulate zooecia, × 25. C. Operculum, × 85. D. Apertura, × 85. E, F. Avicularian mandibles, × 85. (A–F after Waters, 1879 and 1885.)

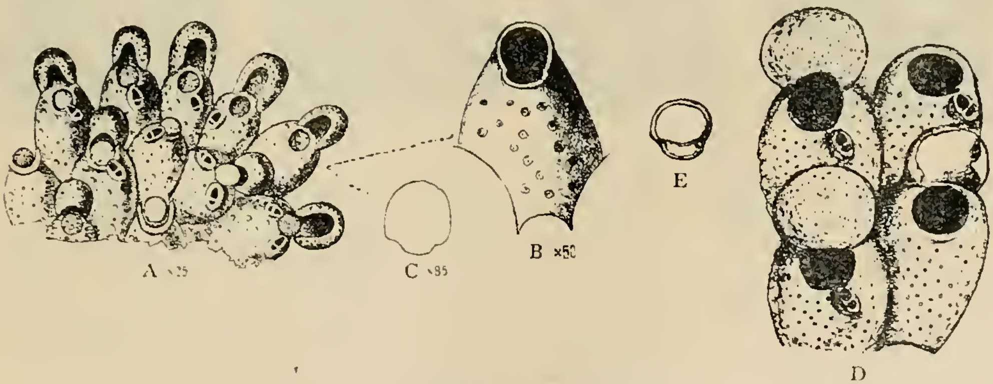


Fig. 185.—*Cellepora janthina* group.

A–E. *Cellepora janthina* Smitt, 1867. A. Group of zooecia, × 25. B. A single zooecium, × 50. C. Operculum, × 85. (A–C after Waters, 1899.) D. Group of ovicelled zooecia. E. Operculum. (D, E after Norman, 1909, as *Cellepora rotundora*.)

In the tangential sections (figs. 11, 12, 14) the zooecia are separated by white lines caused by the frontal convexity. The olocystal elements (figs. 12, 14) are oriented in radial fibers around the lyrula. These fibers are visible even on the internal walls (fig. 6). When the section is deeper (fig. 13) the zooecia are separated by the habitual black line; the olocystal elements of the walls are grouped in more or less diffused links. The transversal fracture of the zoarium (fig. 9) indicates a concentric lamellar structure, the use of which is yet to be demonstrated.

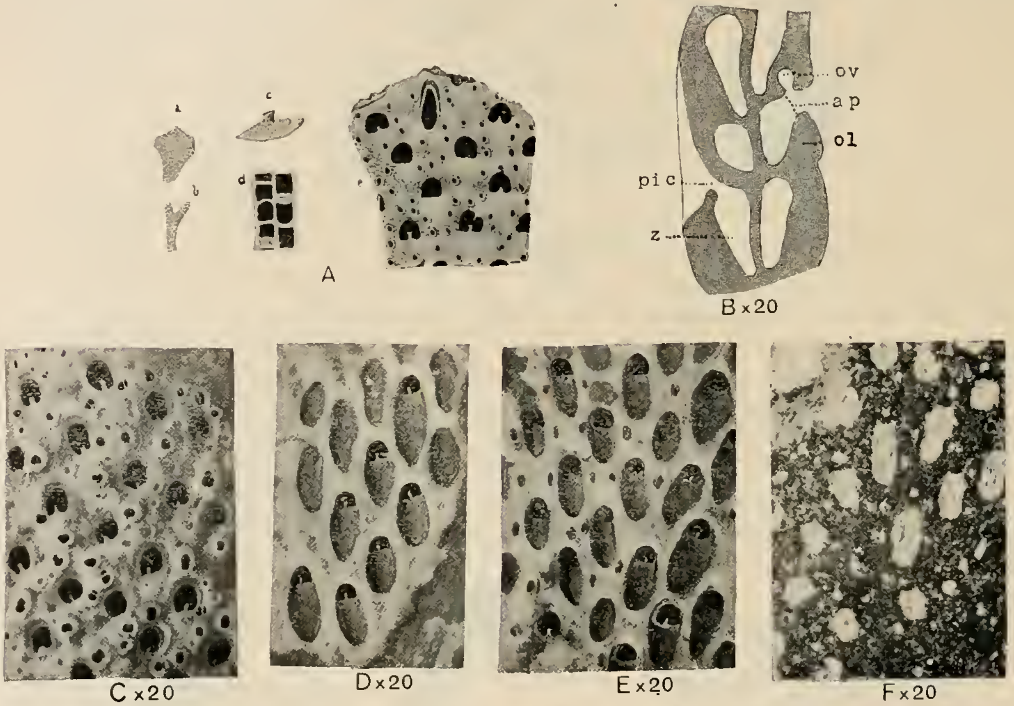


Fig. 186.—Genus *Acanthionella* Canu and Bassler, 1917.

A–F. *Acanthionella typica* Gabb and Horn, 1862. A. View of the bifoliate zoarium (*a*, *b*), the incrusting base, natural size (*c*), the two lamellae (*d*), and the surface (*e*), enlarged, showing the lyrula and the pores. (After Gabb and Horn, 1862.) B. Schematic drawing of a vertical section, × 20. *ap*, apertura; *ol*, olocyst; *ov*, ovicell; *pic*, peristomice; *z*, zooecium. C. Photograph of the surface, × 20. The lyrula and the olocyst frontal with avicularia are shown. D. Interior of the zooecia, × 20, illustrating occurrence of lyrula. E. Another interior, × 20, with the ovicell showing in three of the zooecia (at the top). F. Tangential thin section through the frontal of the zooecia, × 25. The olocystal structure of the frontal is shown. Cretaceous (Vincentown), Vincentown, New Jersey.

*Affinities.*—This species differs from *Acanthionella typica* Gabb and Horn, 1862, in its frontal gibbosities and in the presence of a *porous* area on the ovicell.

*Occurrence.*—Claibornian (Gosport sand): Claiborne, Alabama (common); 1 mile south of Rockville, Clarke County, Alabama (very common); Gopher Hill, Tombigbee River, Alabama (rare).

Lower Jacksonian (Moodys marl): Jackson, Mississippi (common).

*Cotypes.*—Cat. No. 63861, U.S.N.M.

#### ACANTHIONELLA SIMPLEX, new species.

Plate 2, fig. 6.

*Description.*—The zoarium is free, bilamellar, bifurcated. The zooecia are indistinctly oriented; the frontal is formed of a thick olocyst bearing a large suborbicular and salient avicularium. The peristome is very deep; the peristomice is oval and bears on its proximal lip a sort of flat and very prominent lyrula. The ovicell is hardly visible exteriorly; it is hyperstomial and opens widely into the peristomie.

*Affinities.*—The only specimen found has been figured. We have not been able to study this species in detail; but it was urgent to mention the occurrence of the genus in this stage.

It differs from *Acanthionella typica* Gabb and Horn, 1862, in the presence of a single frontal avicularium (and not 3 or 4) and in its lyrula attached to the peristomice (and not to the apertura).

It differs from *Acanthionella oecioporosa* in the absence of frontal gibbosities and in the rarity of its frontal avicularia.

*Occurrence.*—Lowest Eocene (Bryozoan bed at base of Aquia formation): Upper Marlboro, Maryland (very rare).

*Holotype.*—Cat. No. 63784, U.S.N.M.

### Genus KLEIDIONELLA Canu and Bassler, 1917.

1917. *Kleidionella* Canu and Bassler, Synopsis of American Early Tertiary Cheilostome Bryozoa, Bulletin 96, United States National Museum, p. 72.

The apertura is oval. The frontal is a very thick olocyst. The ovicell is hyperstomial and lodged in the olocyst of the distal zooecia; it opens into the peristomie. There are some small and some large interzooecial avicularia. No lyrula.

*Genotype.*—*Kleidionella grandis* Canu and Bassler, 1917.

*Range.*—Claibornian—Vicksburgian.

The abundance of cumulate zooecia and the absence of lyrula distinguishes this genus from the preceding one, *Acanthionella.*

#### KLEIDIONELLA GRANDIS Canu and Bassler, 1917.

Plate 78, figs. 1–17; plate 79, fig. 1.

1917. *Kleidionella grandis* Canu and Bassler, Synopsis of American Early Tertiary Cheilostome Bryozoa, Bulletin 96, United States National Museum, p. 72, pl. 6, figs 9, 10.

*Description.*—The zoarium is very *large*, compressed, formed of bifurcated fronds almost in the same plane, attaining toward the base 2 cm. 5 mm. in width. The zooecia are disposed in two groups, back to back, and inseparable. The axial zooecia, back to back, are oriented; all the other zooecia are cumulate. The superficial zooecia are distinct, urceolate, little raised, very oblique; the frontal is quite convex, smooth, bearing 0 to 3 improminent avicularia with pivot; the frontal is formed of a very thick olocyst. The apertura is oval, deeply imbedded at the base of a peristomie; the peristomice is irregular, suborbicular. The deep zooecia have a flat frontal, their avicularia are prominent between the superficial zooecia. The interzooecial avicularia are distinct, elliptical, of the size of zooecia; they have a pivot; their orifice is like the beak of a duck; the passage of the reflexor muscles of the operculum is indicated by the very small perforations on the inferior cavity; the beak is salient above the zoarium. The incomplete zooecia are quite numerous. On many zoaria there are some distinct groups of large zooecia and of small zooecia.

*Measurements.*—Apertura (interior) $\left\{\begin{array}{l} ha=0.15\text{ mm.} \\ la=0.15\text{ mm.}\end{array}\right.$ Zooecia (interior) $\left\{\begin{array}{l} Lz=0.60\text{ mm.} \\ lz=0.30\text{–}0.35\text{ mm.}\end{array}\right.$

*Variations.*—Following the rule, the variations of these Cellepores are quite great, but the species is always rather easy to determine by its zoarial size.

The two primitive lamellae of the Eschara are back to back and their zooecia are oriented. It is easy to verify this phenomenon in the longitudinal sections (pl. 78, fig. 14), in the transversal section (pl. 78, fig. 15), in the interior (pl. 78, fig. 17). The Cellepores are therefore Cheilostomes perfected by the superficial budding which does not exist in other families. The exterior zooecia are cumulate but never very much raised. Many zoaria (pl. 78, fig. 11) have some groups of large zooecia (pl. 78, fig. 9) perfectly distinct from the groups of smaller, flat zooecia (pl. 78, figs. 10, 12, 13). The reason for this dimorphism is absolutely unknown to us; to determine it, it would be necessary to examine a very large number of specimens as complete and perfect as possible. The total regeneration appears to have affected many of the interzooecial avicularia and some small frontal avicularia, as in figure 7 of plate 78.

The tangential sections are very difficult to interpret, but they are very instructive. We there note above all the disorder characteristic of the Celleporidae: no regularity, no symmetry. Figure 1, plate 79, shows a section nearest the surface; the structure of the frontal walls appears in place or is only manifested by the black circles, for the olocyst is very compact; the white marks which surround these walls result from the convexity of the zooecia, which are only adjacent at their base. Figure 16 of plate 78 shows a deeper section at the level where the zooecial walls are adjacent; the zooecial convexity is raised and the zooecia are white.

*Occurrence.*—Lower Jacksonian (Moodys marl): Jackson, Mississippi (common); 2½ miles north of Roberts, Mississippi (common).

Middle Jacksonian: Wilmington, North Carolina (common); 3½ miles south of Perry, Georgia (common).

Jacksonian (Zeuglodon zone): Cocoa post office, Choctaw County, Alabama (very common); Pachuta, Clarke County, Mississippi (very common); south side of Suck Creek, Clarke County, Mississippi (common).

Vicksburgian (Red Bluff clay): Seven and one-half miles from Bladen Springs, Alabama (rare); Red Bluff, Wayne County, Mississippi (rare).

*Cotypes.*—Cat. Nos. 62613, 64225, 64226, U.S.N.M.

### KLEIDIONELLA PARASITICA, new species.

Plate 16, figs. 17–22.

*Description.*—The zoarium is massive, originally spread out over the radicles of algae; it afterwards emits bilamellar and eschariform fronds, in which the axial zooecia are oriented. The superficial zooecia are salient, globular, oblique; their frontal is very convex, smooth and formed of a very thick olocyst; it bears 0 to 3 small, elliptical avicularia, somewhat salient, with pivot. The apertura is oval, very deep; the peristomice is elliptical. The avicularia of the deep zooecia are more salient. The interzooecial avicularia are as large as the zooecia, elliptical, provided with a pivot and with a rounded beak. On the bilamellar branches the zooecia are oriented; they are elongated, somewhat distinct; the frontal is smooth, convex and garnished with three elliptical avicularia, little salient, with pivot. The very young zooecia have a large peristomice.

*Measurements.*—Apertura (interior) $\left\{\begin{array}{l} ha=0.12 \text{ mm.} \\ la=0.08 \text{ mm.} \end{array}\right.$

Peristomice (exterior) $\left\{\begin{array}{l} hpe=0.20 \text{ mm.} \\ lpe=0.14 \text{ mm.} \end{array}\right.$

Zooecia (interior) $\left\{\begin{array}{l} Lz=0.44 \text{ mm.} \\ lz=0.30\text{–}0.36 \text{ mm.} \end{array}\right.$

*Variations.*—The fronds with oriented zooecia and with two lamellae, back to back, are not rare (figs. 18, 20, 21); at their base they bear some cumulate zooecia. The latter (fig. 22) are abundant on the incrusting zoaria. They have a distinct but little salient peristome. The lower face (fig. 19) of the incrusting zoaria presents nothing particularly remarkable.

*Affinities.*—This species differs from *Kleidionella grandis* in its very small zoarium and in its smaller zooecia.

It differs from *Kleidionella lobata* in the constant presence of the cumulate zooecia, the rarity of the oriented zooecia, and the presence of the large interzooecial avicularia.

*Occurrence.*—Lower Jacksonian: Three and one-half miles southeast of Shell Bluff Post Office, Georgia (common).

*Cotypes.*—Cat. No. 63860, U.S.N.M.

### KLEIDIONELLA LOBATA, new species.

Plate 79, figs. 2–14.

*Description.*—The zoarium is free, compressed, formed of lobed bifurcated fronds borne on an expanded base; it is formed of two lamellae, back to back, and it bears some zooecia almost always oriented and very rarely cumulate. The oriented zooecia are indistinct; their frontal is thick, little convex, and bears one to five small elliptical avicularia, little salient, with pivot. The apertura is oval, deeply imbedded at the base of the peristomie; the peristomice is elliptical, elongated, not garnished with a peristome. The ovicell is hyperstomial, little salient, convex, transverse, smooth; it opens into the peristomie by a very large opening. The interzooecial avicularia are of the size of the zooecia; they have a pivot placed quite low; their beak is round and not salient. The cumulate zooecia are very rare; they are globular, oblique, very convex and bear one or two frontal avicularia.

*Measurements.*—Peristomice (exterior) $\begin{cases} hpe=0.14 \text{ mm.} \\ lpe=0.10 \text{ mm.} \end{cases}$

Zooecia $\begin{cases} Lz=0.40\text{–}0.48 \text{ mm.} \\ lz=0.30 \text{ mm.} \end{cases}$

*Variations.*—The peristomice may be mistaken for the apertura in the very young zooecia (fig. 4) at the extremities of the fronds. The ovicell is formed rather slowly (fig. 4) and is easily broken (figs. 5, 8). The cumulate zooecia are extremely rare; they sometimes appear isolated (figs. 5, 9); but at other times they are grouped (figs. 10, 11). Their presence, even accidental, proves that this species is well classed in its true genus and that it is a Celleporid.

The olocyst is so compact that it is impossible to obtain its microstructure (fig. 12) in tangential section; as in the other Celleporidae the zooecial limits are not visible in such sections.

The longitudinal section shows (fig. 13) short zooecia with thick walls and an oblique apertura.

*Affinities.*—This species differs from *Kleidionella parasitica* and *Kleidionella grandis* in the almost complete absence of cumulate zooecia and in its very characteristic zoarium.

It differs from *Kleidionella cristata* in the fronds of the zoarium, which are wider and deprived of median crest.

Its zoarium often exceeds one centimeter in length, and we may consider it as a good-sized fossil.

*Occurrence.*—Middle Jacksonian: Wilmington, North Carolina (very common); near Lenuds Ferry, South Carolina (common); Entaw Springs, South Carolina (rare); Baldock, Barnwell County, Georgia (rare).

*Cotypes*—Cat. No. 64227, U.S.N.M.

### KLEIDIONELLA CRISTATA, new species.

Plate 77, figs. 12–21.

*Description.*—The zoarium is formed of elongated, bilamellar fronds, composed of two lamellae, back to back; the cumulate zooecia are grouped on the zoarial axis, thus thickening it and forming a characteristic longitudinal *crest.* The oriented zooecia are elongated, little distinct, rhomboidal; the frontal is thick, little convex, formed of a little compact olocyst; it bears one or two elliptical avicularia, little salient with pivot. The peristomice is elongated, elliptical; the apertura is oval, very finely denticulated. The ovicell is hyperstomial, transverse, salient, convex, smooth; it opens widely into the peristomie. The cumulate zooecia occupy the median part of the young fronds, but they totally overspread the fronds at the base of the zoarium; they are globular, very salient, and bear a frontal avicularium. The interzooecial avicularia are as large as the zooecia; they have a pivot; they are elliptical and their beak is round and little salient; they are chiefly disposed on the edge of the fronds.

*Measurements.*—Peristomice $\left\{\begin{array}{l} hpe=0.20\text{ mm.}\\ lpe=0.15\text{ mm.}\end{array}\right.$ Zooecia $\left\{\begin{array}{l} Lz=0.60\text{ mm.}\\ lz=0.35\text{–}0.40\text{ mm.}\end{array}\right.$

*Variations.*—There are three sorts of branches. The younger ones are formed entirely of oriented zooecia (fig. 14); the median crest exists, however, and the zooecia are there distinct. The older ones have some cumulate zooecia on the median crest (figs. 15, 16, 19). Finally, the fragments of the base are uniquely covered with cumulate zooecia (fig. 17), among which are found some interzooecial avicularia. The presence of the interzooecial avicularia on the edge of the zoarium (fig. 18) is inexplicable. The phenomenon is rather frequent in many Cretaceous Cheilostomes with olocystal frontal.

The tangential section (fig. 20) is interesting because it shows the structure at different depths; the olocystal elements (fig. 21) are scattered.

*Affinities.*—This species differs from *Kleidionella lobata* in the almost constant presence of the cumulate zooecia and in its narrower and more elongated fronds.

It differs from *Kleidionella parasitica* in its smaller zooecial dimensions and in the very peculiar nature of the fronds.

*Occurrence.*—Middle Jacksonian: Near Lenuds Ferry, South Carolina (very common).

*Cotypes.*—Cat. No. 64224, U.S.N.M.

### KLEIDIONELLA VERRUCOSA, new species.

Plate 101, figs. 1–11; plate 102, figs. 1–4.

*Description.*—The zoarium is free, formed of two layers, back to back, of cumulate zooecia, bilamellar at the summit, multilamellar at the base; the fronds are thick, compressed, elongated, bifurcated. The young zooecia are oriented, distinct, elongated; the frontal is smooth, very convex, bears an elliptical avicularium, salient, with median pivot. The apertura is oval and deep; the peristomice is elliptical. The ovicell is hyperstomial, salient, convex, smooth; it opens widely into the peristomie. The cumulate zooecia are salient, ovoid, smooth, often deprived of frontal avicularium. The interzooecial avicularia are salient, somewhat larger than the zooecia; they have a pivot and their beak is very round.

*Measurements.*—Apertura $\left\{\begin{array}{l} ha=0.12\text{ mm.}\\ la=0.06\text{ mm.}\end{array}\right.$

Zooecia $\left\{\begin{array}{l} Lz=0.50\text{–}0.60\text{ mm.}\\ lz=0.30\text{ mm.}\end{array}\right.$

*Variations.*—The cumulate zooecia are often grouped together as *wart-like* projections among the oriented zooecia (pl. 101, fig. 6). The latter are visible only on the bilamellar zoaria (pl. 101, fig. 3). they are visible in transverse sections (pl. 102, fig. 2) or longitudinal sections (pl. 102, fig. 4) of the other zoaria. There are all sorts of transitions between the frontal avicularia (pl. 101, fig. 4) and the interzooecial avicularia. The zoarium may attain 1½ centimeters in length and may be considered as a good-sized fossil, easy of determination in the field.

In tangential sections (pl. 102, fig. 3) the zooecial walls are seen to be formed of very dense olocystal elements.

*Affinities.*—This species differs from *Kleidionella cristata*, in which the fronds have almost the same form, in its larger cumulate zooecia, never grouped especially in the middle of the fronds, and in the rarity of the oriented zooecia uniquely arranged at the extremity of the branches.

It differs from *Kleidionella lobata* in the presence of its numerous cumulate zooecia.

*Occurrence.*—Vicksburgian ("Chimney rock" member of Marianna limestone) ; One mile north of Monroeville, Alabama (extremely common).

*Cotypes.*—Cat. No. 64327, U.S.N.M.

## Family CONESCHARELLINIDAE Levinsen, 1909.

The zooecia are erect; the apertura is terminal. The gemmation is always and uniquely lateral. The ovicell is hyperstomial and recumbent. There is both a zooecial and a zoarial hydrostatic system.

*Historical.*—The first specimens discovered were confused with *Selenaria* Busk, 1852, and *Lunulites*. In 1887 Whitelegge formed the genus *Bipora* for the species whose apertura were provided with a rimule. In 1910 Maplestone created the family Biporae. Prior to that, in 1900, Neviani grouped the genera *Batopora* Reuss, 1847, and *Conescharellina* D'Orbigny in his family of the Batoporidae, whereas *Stichoporina* Stoliczka, 1861, and *Orbitulipora* Stoliczka, 1861, remained in Lepraliidae. *Bipora* Whitelegge, 1887, was classed in 1895 in Schizoporellidae by MacGillivray. In 1909 Levinsen made a somewhat serious study on the recent genera *Bipora* Whitelegge, 1887, *Conescharellina* O'Drbigny, 1851, and *Flabellipora* D'Orbigny, 1851, and all of the group with rimule of the Biporae; he omitted the recent genus *Fedora* Jullien, 1882. No author has regarded the family in its entirety and the right of priority does not exist.

This is a very mysterious group, which has given the zoologists much trouble until, in 1910, when Maplestone[1] presented some details on the zoarial life.

Almost all our specimens belong to a new American genus, *Schizorthosecos*.

The zooecial hydrostatic system is analogous to that which we have described for *Lunularia* Busk, 1884, but with some variations still very imperfectly studied. Around the ancestrula there are some hydrostatic and radicular zooecia and often between the zooecia there are some hydrostatic zooeciules and some zooeciules of reenforcement or compensation. The inner surface of the zoarium being smaller than the external surface, the latter have for their object the making up the difference.

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[1] 1910. On the Growth and Habits of Biporae, Proceedings Royal Society Victoria, vol. 23.

### Genus FEDORA Jullien, 1882.

1882. *Fedora* JULLIEN, *Dragages du Travailleur*, Bulletin Société Zologique France, vol. 7, p. 17. (*Kionidella* Koschinsky, 1885.)

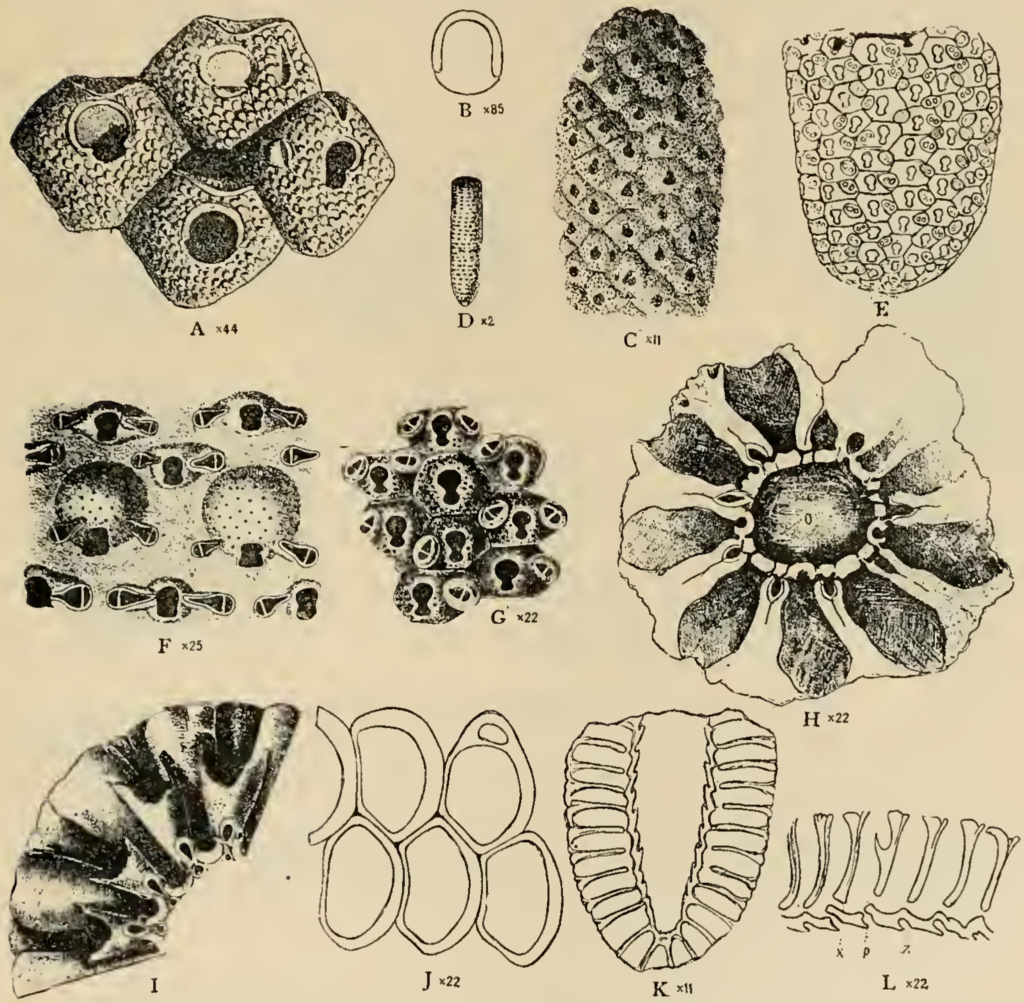

FIG. 187.—Genus *Fedora* Jullien, 1882.

A–C. *Fedora edwardsi* Jullien, 1882. A. Zooecia, × 44. B. Operculum, × 85. (After Waters, 1891.) C. Zoarium, × 11. (A, C after Jullien, 1882.)

D–L. *Fedora excelsa* Koschinsky, 1885. D. Zoarium, × 2. (After Waters, 1891.) E. Zoarium, magnified. F. Ovicelled zooecia, × 25. (After Waters, 1891.) G. Ordinary zooecia, × 22. H. Transversal section showing the zooecia and the basal septules, × 22. I. Transversal break showing that the zooecia arise on the internal walls of the zoarium. J. Tangential section, × 22, taken just below the surface. K. Longitudinal section through a zoarium, × 11. L. Enlargement of a longitudinal section, × 22, showing the basal septules (*p*), parietal septules (*x*), and the hydrostatic cavity (*z*). (E, G–L after Koschinsky, 1885.)

"Zooecia subhexagonal with circular orifice, thick but not salient, notched on its posterior fourth where it is thin; finally placed a little above the center of the zooecium, of which it occupies about a third of the diameter; the ovicell nonsalient, indicated exteriorly by a smooth stripe forming an obtuse angle, of which the summit is turned toward the orifice. Avicularia not constant, situated on the sides and outside of the orifice." (Jullien, 1882.)

*Genotype.*—*Fedora edwardsi* Jullien, 1882.

*Range.*—Lutetian—Recent.

The known species of this genus are:

*Fedora edwardsi* Jullien, 1882. Recent.

*Fedora* (*Kionidella*) *obliqueseriata* Koschinsky, 1885. Lutetian.

*Fedora* (*Kionidella*) *excelsa* Koschinsky, 1885. Lutetian.

*Fedora* (*Discoflustrellaria*) *dactylus* D'Orbigny, 1881. Lutetian.

The recent species has been dredged at a depth of 2,018 meters.

### FEDORA PUSILLA, new species.

Plate 102, figs. 14–17.

*Description.*—The zoarium is *small*, very conical, hollow. The zooecia are tubular, indistinct, separated exteriorly by some hydrostatic zooeciules. The apertura is suborbicular and formed of a large anter separated by two small cardelles from a smaller poster. The ovicell is hyperstomial, very little salient; it is opened by a very thin slit above the operculum; it is borne by a larger zooecium. Six inferior septules.

*Occurrence.*—Vicksburgian (Byram marl): One-fourth mile west of Woodwards, Wayne County, Mississippi (rare).

*Cotypes.*—Cat. No. 64331, U.S.N.M.

### Genus STICHOPORINA Stoliczka, 1861.

1861. *Stichoporina* Stoliczka, Oligocäne Bryozoen von Latdorf in Bernburg Sitzungsberichte der k. Akademie der Wissenschaften, Wien, vol. 45, Abth. 1, 1862, pp. 71–74. pls. 1–3.

The zoarium is cupuliform. The apertura is orbicular or elliptical with two cardelles; the apertura of the ovarian zooecia is larger and transverse. The avicularia have some vibraculoid mandibles.

*Genotype.*—*Stichoporina reussi* Stoliczka, 1861.

*Range.*—Lutetian—Recent.

The known species of this genus are:

*Stichoporina reussi* Stoliczka, 1861. Lutetian, Latdorfian, Recent. (=*Stichoporina simplex* Koschinsky, 1885.)

*Stichoporina protecta* Koschinsky, 1885. Lutetian, Priabonian.

*Stichoporina crassilabris* Koschinsky, 1885. Lutetian.

*Stichoporina* (*Lepralia*) *minutissima* Seguenza, 1880. Helvetian.

*Stichoporina persimplex* Neviani, 1895. Plaisancian.

### STICHOPORINA PROTECTA Koschinsky, 1885.

Plate 79. figs. 15–18.

1885. *Stichoporina protecta* Koschinsky, Ein Beitrag zur Bryozoenfauna der älteren Tertiärschichten des südlichen Bayerns, Abth. 1, Cheilostomata, Paleontographia, vol. 32, p. 65, pl. 6, figs. 8–11.

1891. *Stichoporina simplex* Waters, North Italian Bryozoa, Quarterly Journal Geological Society, London, vol. 47, p. 31, pl. 4, figs. 16–18.

1909. *Stichoporina protecta* Canu, Bryozoaires des terrains tertiaires des environs de Paris, Annales de Paleontologie, vol. 4, p. 101, pl. 11, fig. 8.

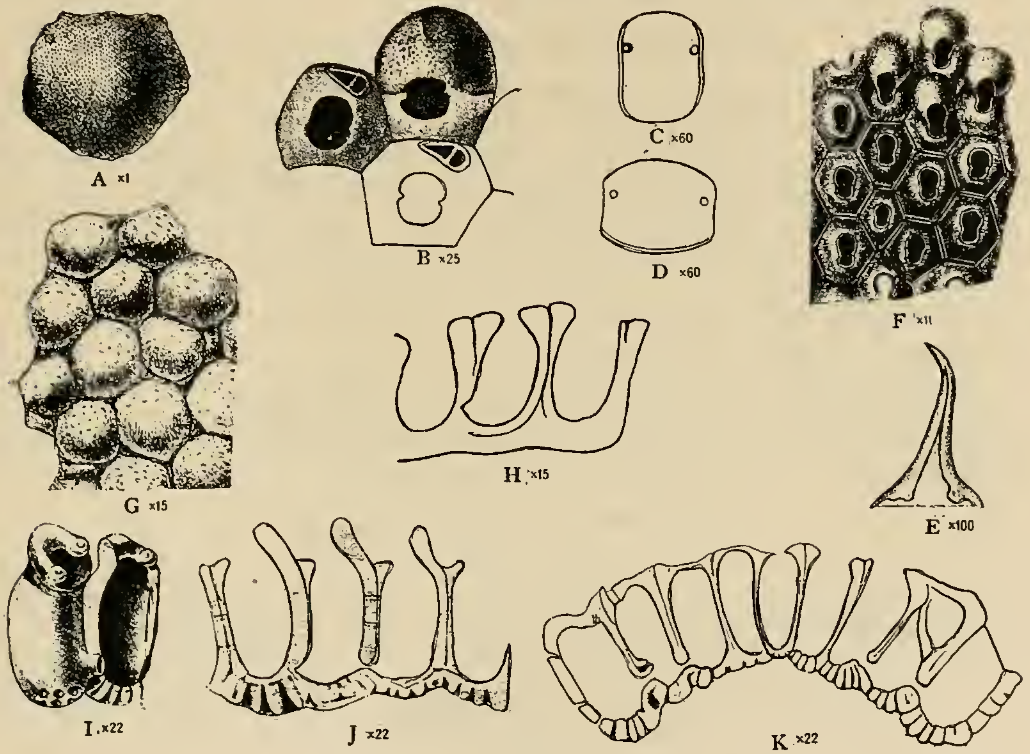

Fig. 188.—Genus *Stichoporina* Stoliczka, 1861.

A–H. *Stichoporina simplex* Koschinsky, 1885. A. Zoarium, natural size. B. Zooecia, × 25. C. Operculum of an ordinary zooecium, × 60. D. Operculum of an ovicelled zooecium, × 60. E. Avicularian mandible, × 100. (A–E after Kirkpatrick, 1890.) F. Zooecia, × 11. G. Internal face, × 15. H. Longitudinal section, × 15. (F–H after Koschinsky, 1885.)

I, J. *Stichoporina cranilabris* Koschinsky, 1885. I. Isolated zooecia, × 22. J. Longitudinal section, × 22, showing the lateral septulae. (I, J after Koschinsky, 1885.)

K. *Stichoporina protecta* Koshchinsky, 1885. Longitudinal section showing the parietal septulae, × 22. (After Koschinsky, 1885.)

*Variations.*—Our specimens very well resemble the specimens previously described by other authors. The apertura of the ovicelled zooecia is larger than the others and transverse (fig. 15); its operculum probably closes the ovicell in opening, in order to facilitate the passage of the eggs. On the lower face (fig. 16) there are often some circular imbrications difficult to explain. In transverse section the zooecia (fig. 18) are tubular; their peristomie forms a narrow gullet.

*Occurrence.*—Middle Jacksonian (Castle Hayne limestone): Wilmington, North Carolina (common).

*Geological distribution.*—Lutetian of Bavaria (Koschinsky) and of the Paris Basin (Canu). Priabonian of the Vicentin (Waters).

*Plesiotypes.*—Cat. No. 64228, U.S.N.M.

### Genus SCHIZORTHOSECOS Canu and Bassler, 1917.

1917. *Schizorthosecos* Canu and Bassler, Synopsis of American Early Tertiary Cheilostome Bryozoa, Bulletin 96, United States National Museum, p. 74.

The zoarium is cupuliform. The apertura is oval with a proximal rounded rimule. There are numerous interzooecial zooeciules capable of being transformed into avicularia, into radicular zooeciules, and into compensation zooeciules. The ovicell is hyperstomial, placed on the distal zooecium and never closed by the operculum.

*Genotype.*—*Schizorthosecos* (*Orbitolites*) *interstitia* Lea, 1833.

*Range.*—Claibornian—Jacksonian.

This genus is exclusively American; it characterizes the Claibornian and the base of the Jacksonian, where it is exterminated unexpectedly.

It differs from *Conescharellina* D'Orbigny, 1851, and *Bipora* Whitelegge, 1887, in its distinct zooecia and in the absence of lunoecia.

### SCHIZORTHOSECOS INTERSTITIA Lea, 1833.

Plate 18, figs. 1–9.

1833. *Orbitolites interstitia* Lea, Contribution to Geology, Philadelphia, p. 191, pl. 6, fig. 204.

1862. *Lunulites interstitia* Gabb and Horn, Monograph fossil Polyzoa Secondary and Tertiary formations North America, Journal Academy Natural Sciences, Philadelphia, ser. 2, vol. 5, p. 120.

1890. *Lunulites* (*Cupularia*) *interstitia* De Gregorio, Monographic Fauna Eocenique de Alabama, Annales de Geologie et de Paleontologie, Livr. 7 and 8, p. 249, pl. 42, figs. 16–22.

1917. *Schizorthosecos interstitia* Canu and Bassler, Synopsis of American Early Tertiary Cheilostome Bryozoa, Bulletin 96, United States National Museum, p. 75, pl. 6, figs. 4, 5.

*Description.*—The zoarium is cupuliform, little deep. The zooecia are distinct, tubular, erect, terminated by a narrowed peristomie. The apertura is placed at the base of the peristomie; in its rimule, it often has a flat lyrula; the peristomice is of the same form as the apertura. Between the peristomes, on the external surface, there are numerous zooeciules, which are transformed according to their position into radicular zooeciules, into avicularia with pivot, or into compensation zooeciules. On the inner face each zooecium is indicated by a hexagon perforated with six to ten large tremopores, which are the orifices of long tubules; some large avicularia with pivot surround the ancestrula.

The ovicell is hyperstomial, placed on the distal zooecium; it is never closed by the operculum; its orifice is large; it is formed of two calcareous layers, of which the external one is frequently incomplete and circumscribes a more or less large frontal area.

*Variations.*—In the interior of certain apertures there is a calcareous arched lamella or indeed a tooth when this lamella is incomplete.

In the interior (fig. 2) the ancestrula is an ordinary zooecium; viewed from the inner face it has the aspect of a circle perforated by three pores (fig. 5) surrounded by a calcareous ring and by six hexagons perforated by three, four or five pores. On the exterior it is surrounded by radicular zooeciules, as is the habit of all the species attached to submarine bodies (figs. 7, 8).

The zooecia are regularly cylindrical; the internal surface is smaller than the external surface; the discrepancy is filled by the zooeciules, which we call compensation zooeciules; they are more or less numerous (fig. 3).

On their inner face, near the ancestrula, there are some large avicularia with bar; their mandible was semielliptical and transverse (figs. 4, 5).

On the external face (fig. 6) there are large membraniporoid zooecia superposed on the others and always situated near the center. Their function is unknown.

The base of the zooecia is perforated; these pores are the extremities of the long tubules which open also on the external face. These tubules must be intended to give lightness to the zoarium.

*Occurrence.*—Claibornian (Gosport sand): Claiborne, Alabama (very common); Gopher Hill, Tombigbee River, Alabama (common); one mile southwest of Rockville, Clarke County, Alabama.

Claibornian (Lisbon formation): Wautubbee Hills, four miles south of Enterprise, Clarke County, Mississippi (common).

Claibornian (Cook Mountain formation): Moseleys Ferry, Caldwell County, Texas (very rare).

Lower Jacksonian: Three and one-half miles southeast of Shell Bluff post office, Georgia (rare).

Lower Jacksonian: Jackson, Mississippi (very common).

*Plesiotypes.*—Cat. No. 62809, U.S.N.M.

### **SCHIZORTHOSECOS GRANDIPOROSUM**, new species.

Plate 18, figs. 10–15.

*Description.*—The zoarium is cupuliform and little concave. The zooecia are distinct exteriorly, tubular, terminated by a contracted peristomie. The apertura is placed at the base of the peristomie; it bears a rounded rimule; the peristomice is oval. The peristomes are separated by some compensation zooeciules with irregular orifices. On their inner face the zooecia are indistinct; they each contain one large and one small pore. At the base of each zooecium there are a dozen very small pores.

*Affinities.*—This species differs from *Schizorthosecos interstitia* Lea, 1833, in the totally different nature of its inner face, which does not bear very numerous small pores of tubules.

*Bipora eburnea*, Mapleston, 1909, is a recent species bearing pores somewhat analogous, but the author has not explained their use.

*Occurrence.*—Claibornian (Gosport sand): Claiborne, Alabama (common).

Lower Jacksonian (Moodys marl): Jackson, Mississippi (rare).

*Cotypes.*—Cat. No. 63863, U.S.N.M.

### SCHIZORTHOSECOS RADIATUM, new species.

Plate 18, figs. 16–19.

*Description.*—The zoarium is cupuliform, very little concave. The zooecia are indistinct exteriorly, tubular, terminated by a contracted peristomie; before each peristomice there are four to six small *radial* costules; above, in the interzooecial angles there are two small compensation zooeciules or avicularia. The apertura is placed at the base of the peristomie and has a rounded, distal rimule; the peristomice has also a very wide and quite variable lower indentation. On the inner face, the radial series are separated by lateral mural rims, very thick and quite salient; the zooecia appear between them in hexagons, smooth, much elongated, little distinct, terminated by an enormous perforation.

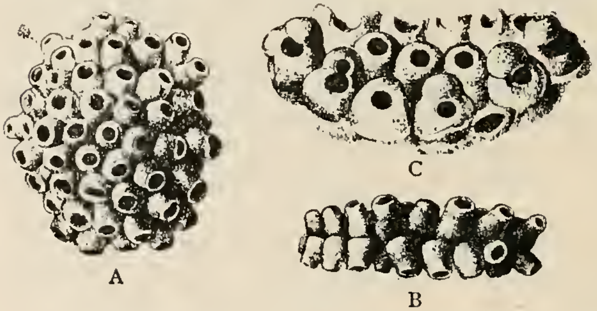

Fig. 189.—Genus *Orbitulipora* Stoliczka, 1861.
A–C. *Orbitulipora petiolus* Lonsdale, 1850. Natural size and magnified views of a zoarium. (After Reuss, 1867.)

*Affinities.*—This species is extremely rare; it is very easily confused with the very abundant specimens of the *Schizorthosecos interstitia* Lea, 1833. To discover specimens of it one must study under the microscope the inner face of all the specimens found. The enormous salient collars, as well as the small frontal radiations, well characterize this species.

*Occurrence.*—Claibornian (Gosport sand): Claiborne, Alabama (rare).

Claibornian (Lisbon formation): Wautubbee Hills, four miles south of Enterprise, Clarke County, Mississippi (very rare).

*Cotypes.*—Cat. No. 63864, U.S.N.M.

### Genus ORBITULIPORA Stoliczka, 1861.

1861. *Orbitulipora* Stoliczka, Olizocäne Bryozoen von Latdorf in Bernburg Sitzungsberichte der k. Akademie der Wissenschaften, Wien, vol. 45, Abth. 1, p. 90.

The apertura is orbicular. The frontal is a tremocyst. The zoarium is orbicular and formed of two lamellae with zooecia back to back.

*Genotype.*—*Orbitulipora haidingeri* Stoliczka, 1861.

*Range.*—Auversian—Tortonian.

*Orbitulipora petiolus* Lonsdale, 1850, *Orbitulipora lenticularis* Reuss, 1867, and *Orbitulipora excentrica* Seguenza, 1880, are the only known species in addition to the genotype.

### Genus BATOPORA Reuss, 1867.

1867. *Batopora* Reuss, Ueber einige Bryozoen aus dem deutschen Unteroligocan Sitzungsberichte der k. Akademie der Wissenschaften, Wien, Abth. 1, p. 16.

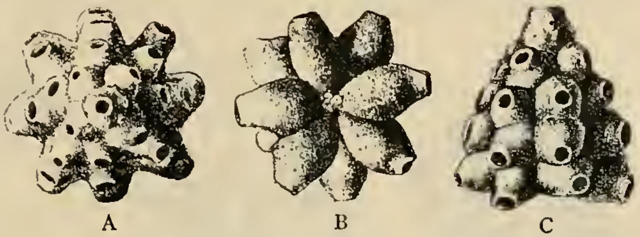

Fig. 190.—Genus *Batopora* Reuss, 1867.

A–C. *Batopora rosula* Reuss, 1867. Frontal, dorsal, and lateral views of a zoarium, magnified. (After Reuss, 1867.)

The apertura is orbicular. The frontal is a granular olocyst. The zoarium is conical, never hollow. The ancestrular zooecium is ornamented with radicular pores.

*Genotype.*—*Batopora stoliczkai* Reuss, 1867.

*Range.* — Lutetian, Tortonian.

The species of this genus are:

*Batopora stoliczkai* Reuss, 1867. Latdorfian.

*Batopora scrobiculata* Koschinsky, 1885. Lutetian.

*Batopora conica* Seguenza, 1880. Tongrian.

*Batopora conica* Hantken (according to Pergens, 1887). Priabonian.

*Batopora multiradiata* Reuss, 1869. Tortonian.

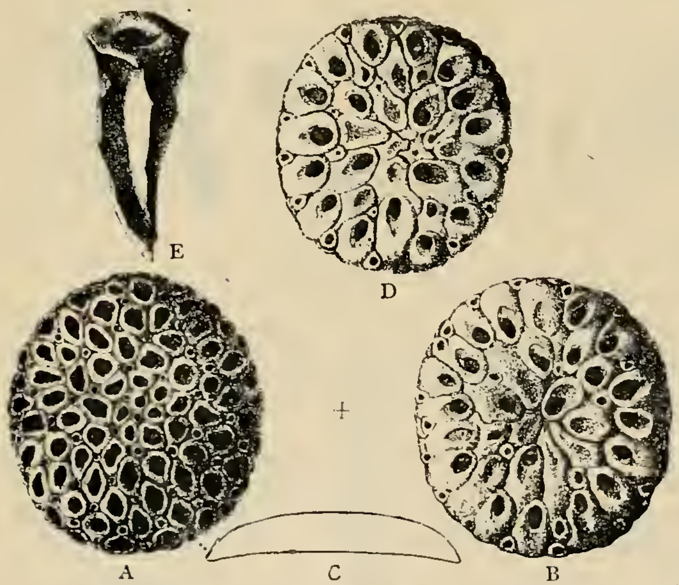

Fig. 191.—Genus *Diplotaxis* Reuss, 1867.

A–E. *Diplotaxis placentula* Reuss, 1867. Various views of the zoarium magnified. (After Reuss, 1867.)

### Genus DIPLOTAXIS Reuss, 1867.

1867. *Diplotaxis* Reuss, Ueber einige Bryozoen aus dem deutschen Unteroligocan, Sitzungsberichte der k. Akademie der Wissenschaften, Wien, Abth. 1, p. 16.

The zoarium is discoidal and formed of two lamellae, back to back. The zooecia of the external face are oriented toward the zoarial margins; the zooecia of the inner face are oriented toward the center. The apertura has a distal rimule.

*Genotype.*—*Diplotaxis placentula* Reuss, 1867. Latdorfian.

### Genus CONESCHARELLINA D'Orbigny, 1851.

1851. *Conescharellina* D'Orbigny, Paleontologie française, Terrain Cretace, vol. 5, p. 446.

The zoarium with lunoecia. The zoaria, which have the form of a low cone or an arched disk, only show a single layer of zooeeia, while their inner cavity is occupied by numerous avicularia placed in horizontal layers; ovicells may occur. (After Levinsen, 1909.) The apertura has a distal rimule.

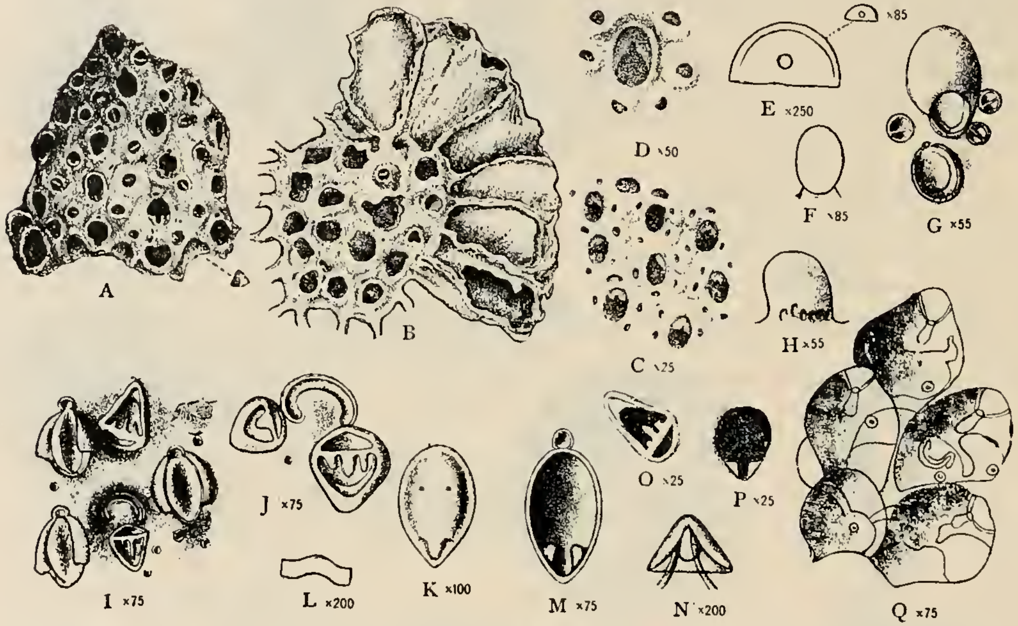

Fig. 192.—Genus *Conescharellina* D'Orbigny, 1851.

A–H. *Conescharellina cancellata* Busk, 1852. A. Zoarium, natural size and magnified. B. Internal face magnified. (A, B after MacGillivray, 1895.) C. Zooecia, × 25. D. Aperture, × 50. (C, D after Waters, 1882.) E. Avicularian mandible, × 85 and × 250. F. Operculum, × 85. (E, F after Waters, 1887.) G. Ovicell, × 55. H. Ovicell from the side. × 55. (G, H after Levinsen, 1909.)

I–N. *Conescharellina angulopora* Tenison-Woods, 1880. I. Between the two avicularia is seen one of the peculiar crescentic apertures belonging to certain kenozooecia (zooecia of compensation), × 75. J. A crescentic aperture and two avicularia, × 75. K. Operculum, × 100. L. A transverse section of the operculum, × 200. M. Aperture, × 75. N. Avicularian mandible, × 200. (I–N after Levinsen, 1909.)

O–P. *Conescharellina incisa* Hincks, 1881. O. Avicularian aperture, × 25. P. Oral aperture, × 25. (O, P after Waters, 1887.)

Q. *Conescharellina philippinensis* Busk, 1852. Five zooecia are seen from the basal side (after removal of the froutal wall), showing a number of avicularian chambers, which are connected partly with the zooecial surface and partly with each other through septules and pore chambers. There is also seen one of the peculiar kenozooecia, which are provided with a narrow semilunate aperture, × 75. (After Levinsen, 1909.)

*Genotype.—Conescharellina cancellata* Busk, 1852.

*Range.*—Miocene—Recent.

The lunoecia are the openings of special compensation zooeciules.

All the unilamellar *Bipora* of Whitelegge, 1887, are classified in this genus by Levinsen.

### Genus BIPORA Whitelegge, 1887.

1887. *Bipora* Whitelegge, Notes on some Australian Polyzoa, Proceedings Linnean Society New South Wales, ser. 2, vol. 11, p. 337.

The zoarium with lunoecia. The zoaria are plate-like or fan-shaped with two layers of zooecia; ovicells are not found. (After Levinsen, 1909.) The apertura has a proximal rimule.

*Genotype.—Bipora umbonata* Haswell, 1880. Recent.

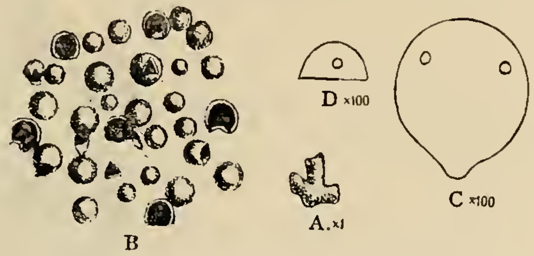

Fig. 193.—Genus *Bipora* Whitelegge, 1887.

A–D. *Bipora umbonata* Haswell, 1880. A. Zoarium, natural size. B. Zooecia and lunoecia magnified. (After Haswell, 1880.) C, D. *Bipora crassa* Tenison-Woods, 1880. Operculum and avicularian mandible, × 100. (After Kirkpatrick, 1890.)

### Genus FLABELLIPORA D'Orbigny, 1852.

1852. *Flabellipora* D'Orbigny, Paleontologie Francaise Terrain Crétacé, vol. 5, p. 432.

The zoaria, which have no lunoecia, are plate-like, two layered; no ovicells. (After Levinsen, 1909.) The apertura has a proximal rimule.

*Genotype.—Flabellipora elegans* D'Orbigny, 1852. Recent.

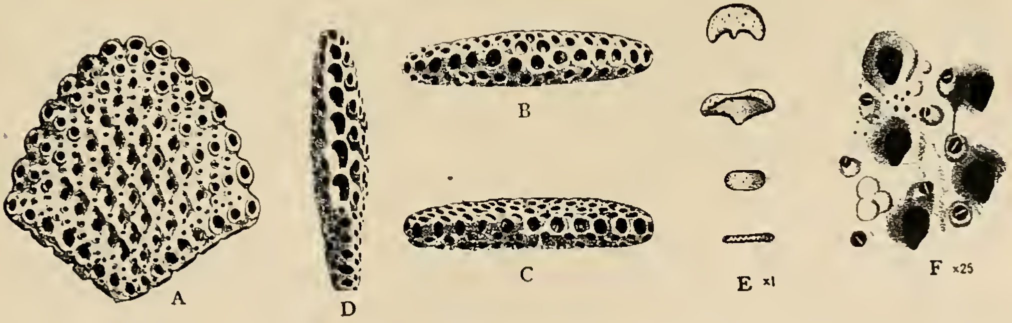

Fig. 194.—Genus *Flabellipora* D'Orbigny, 1852.

A–F. *Flabellipora elegans* D'Orbigny, 1852. A–D. Four views of the enlarged zoarium. (After D'Orbigny, 1852.) E. Various aspects of a zoarium natural size. F. Zooecia and avicularia, × 25. (E, F after Waters, 1887.)

### Genus MAMILLOPORA Smitt, 1872.

1872. *Mamillopora* Smitt, Floridan Bryozoa, Pt. 1. Kong. Svenska Vetenskaps Akademiens Handlingar, vol. 10, No. 11, p. 33.

The zoarium is cupuliform. The apertura is elliptical with two submedian cardelles. There are some avicularia between the zooecia. The ovicelled zooecia are much larger; their apertura is not transverse.

*Genotype.—Mamillopora cupula* Smitt, 1872. Recent (Florida).

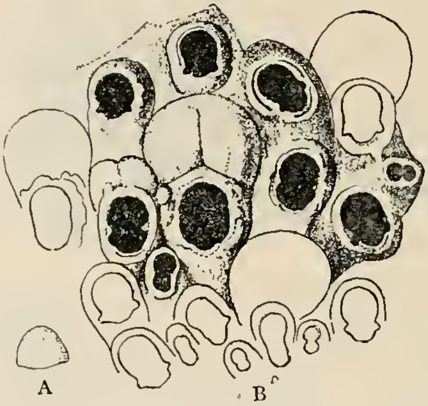

Fig. 195.—Genus *Mamillopora* Smitt, 1872.

A, B. *Mamillopora cupula* Smitt, 1872. Zoarium, natural size, and zooecia, enlarged. (After Smitt, 1872.)

# Order CYCLOSTOMATA Busk.

Zooecia very simple, cylindrical, calcareous tubes arising from a proximal tube by some special mode of gemmation, usually without transverse partitions; orifice plain, inoperculate, not contracted; walls thin, minutely porous; apertural portion of zooecial tubes more or less raised, bent outwards, free or in bundles. Marsupia and appendicular organs wanting. Ovicell an enlarged zooecium or an inflation of the zoarial surface.

Hitherto the families and genera of Cyclostomata have been founded almost entirely upon the form of the zoarium and the arrangement of the zooecia. Various classifications have been proposed, but it is needless to review them here because Gregory in 1909[1] gave a good account of them and discussed the general problem of classification at some length.

The distinction between the families of Cyclostomata, like the other orders of Bryozoa, is or should be based on their larval forms, each family being charaterized by a special larva. The larvae of the Cyclostomata are very similar to each other and difficult to discriminate, but fortunately they show their differences by the evolution of the embryos in ovicells of very different size, form, and position.

We believe that the same principles of classification as are applied to the apparently more complicated Cheilostomata (see pp. 70, 71) can be employed in the study of the Cyclostomata, indeed, that a natural classification can be built up by a study of the physiologic functions of the organs. In the Cheilostomata it will be noted that the form of the aperture and of the operculum, the presence of the cardelles, occurrence of lyrula and the ovicell were the essential characters of generic and family classification. In the Cyclostomata the aperture is always more or less circular, the operculum, cardelles, and lyrula are wanting, leaving the ovicell as the single remaining essential character showing on the zooecium. The value of the ovicell in the classification of the Cyclostomata is therefore of utmost importance, but unfortunately until very recently its study has been much neglected.

The most important work on the ovicells of recent species is that of Waters, published in 1894[2] and 1914[3]. In 1893[4] the remarkable phenomenon whereby a single egg can engender a considerable number of larvae was discovered by Harmer. This discovery of the fissiparity of the primary embryo explains the rarity of ovicells.

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[1] Catalogue Fossil Bryozoa in Department of Geology, British Museum, vol. 2, pp. xxiv–xli.

[2] 1894. Waters, Ovicells of Cyclostomatous Bryozoa, Linnean Society Journal, vol. 20, pp. 275–285, pl. 14, 15.

[3] 1914. Waters, The marine fauna of British East-Africa, Proceedings of the Zoological Society, pp. 834–836.

[4] 1893. Harmer, Embryonic Fissión in Cyclostomatous Bryozoa, Quarterly Journal of Miscroscopical Science (n. s.), vol. 34, pp. 199–241, pls. 21–24.

The ovicells on the fossil forms have not escaped observation as D'Orbigny, Hagenow, Reuss, and Pōcta have figured them, although these students did not recognize their great value in classification. In 1897[1] Canu discovered the ovicell of the Melicerititidae, and in 1899[2] that of the Ceidae. In 1898[3] he published some special variations and indicated the great necessity for the study of the ovicell. In 1918[4] he published a summary of his new ideas on the classification of the Cyclostomata with descriptions of a number of new genera, a work which was preliminary to the present one where these ideas are more fully developed.

## GENERAL CONSIDERATION OF THE CYCLOSTOMATA.

### THE TUBES.

The zooecia of the cyclostomatous bryozoa are tubular.. Whatever may be the zoarial form, each tube grows from a proximal tube by a special mode of gemmation (fig. 196 A, B).

Considering the form of the tubes there are:

(*a*) Club-shaped tubes or typical Cyclostomata.
(*b*) Cylindrical tubes or Cyclostomata resembling the trepostomatous bryozoa
(*c*) Tubes with facets.
(*d*) Tubes with rhomboidal orifice.

This division, however, is not an absolute one. Hollow zoaria (in the Cavaria form of growth) often have shortened tubes the exact nature of which it is impossible to determine. In the zoarium of *Lichenopora*, the polypidian tubes are club-shaped and the accessory tubes cylindrical.

Considering their functions the tubes are classed as follows:

(*a*) Polypidian tubes.
(*b*) Accesory tubes (=aborted tubes of authors).
(*c*) Adventitious tubes.

The tubes are often grouped in longitudinal, transversal, or radial bundles (fascicles) which may be monoserial or pluriserial.

*Calcification.*—The ectocyst is formed of two thin, flexible membranes between which the calcareous skeleton is located (fig. 196 C)[5]; the tubes are therefore not strictly adjacent. The disappearance of the external membrane leaves a space which, in thin sections, appears as a clear line. This intercellular space is quite variable in size and is linear or vesicular. At the center of the agglomerate zoaria the tubes are often adjacent by reduction, reabsorption or filling up; rarely they are so in the entire zoarium (see *Exochoecia*).

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[1] 1897. Canu, Bryozoaires du Turonien des Janières, Bulletin Société Géologique de France, ser. 3, vol. 25, p. 155.

[2] 1899. Canu, Les Ovicelles des Céidées, Bulletin Société Géologique de France, ser. 3, vol. 27, p. 326.

[3] 1898. Canu, Etude sur les Ovicelles des Bryozoaires du Bathonien d'Occaignes, Bulletin Société Géologique de France, ser. 3, vol. 26, p. 259.

[4] 1918. Canu, Les Ovicelles des Bryozoaires Cyclostomes, Bulletin Société Géologique de France, ser. 4, vol. 16, pp. 324–335.

[5] 1900. Calvet. Contributions a l'histoire naturelle des Bryozoaires ectoproctes marins, Travaux Institut Zoologique Université Montpellier Mém., No. 8, p. 166.

The calcareous skeleton is exteriorly porous (fig. 196 A, D). At each pore in the general cavity[1] there are corresponding spherular leucocytes (fig. 196 E).

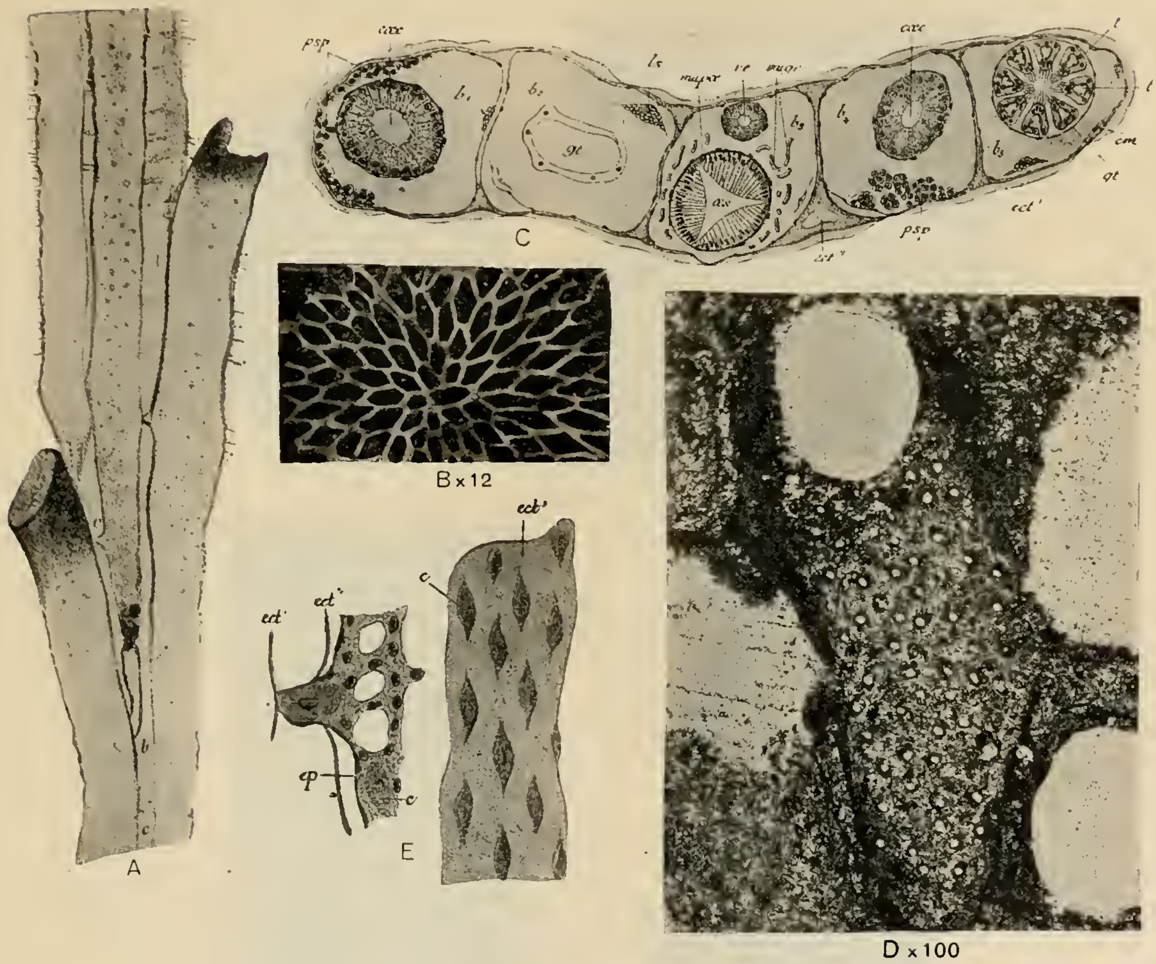

FIG. 196.—Structure of the tubes.

A. Longitudinal section of *Entalophora raripora* D'Orbigny enlarged, showing that each tube grows from the dorsal of the proximal tube. (After Beissel, 1865.) B. Tangential section of the dorsal side of *Plagioecia concreta* new species, × 12, illustrating the spindle-shaped aspect of the tubes. C. Transverse thin section of a branch of *Crisia denticulata* Lamarck, 1836; *ect* represents the ectocyst. (See text figure 229 for complete description.) D. Tangential thin section, × 100, of the frontal of *Filisparsa ingens* new species, illustrating the porous walls. E. Tangential thin section of the ectocyst of *Crisia denticulata* Lamarck, 1836. Each of the pores corresponds to a spherular leucocyte. (C, E after Calvet, 1900.)

The pores serve therefore for respiration. The tubes communicate by septulae (fig. 196 A), which are more or less numerous, very small and irregularly placed.

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[1] Calvet. Contributions a l'histoire naturelle des Bryozoaires ectoproctes marins, p. 239.

These septulae serve as in the Cheilostomata, for the passage of the mesenchymatous fibers.

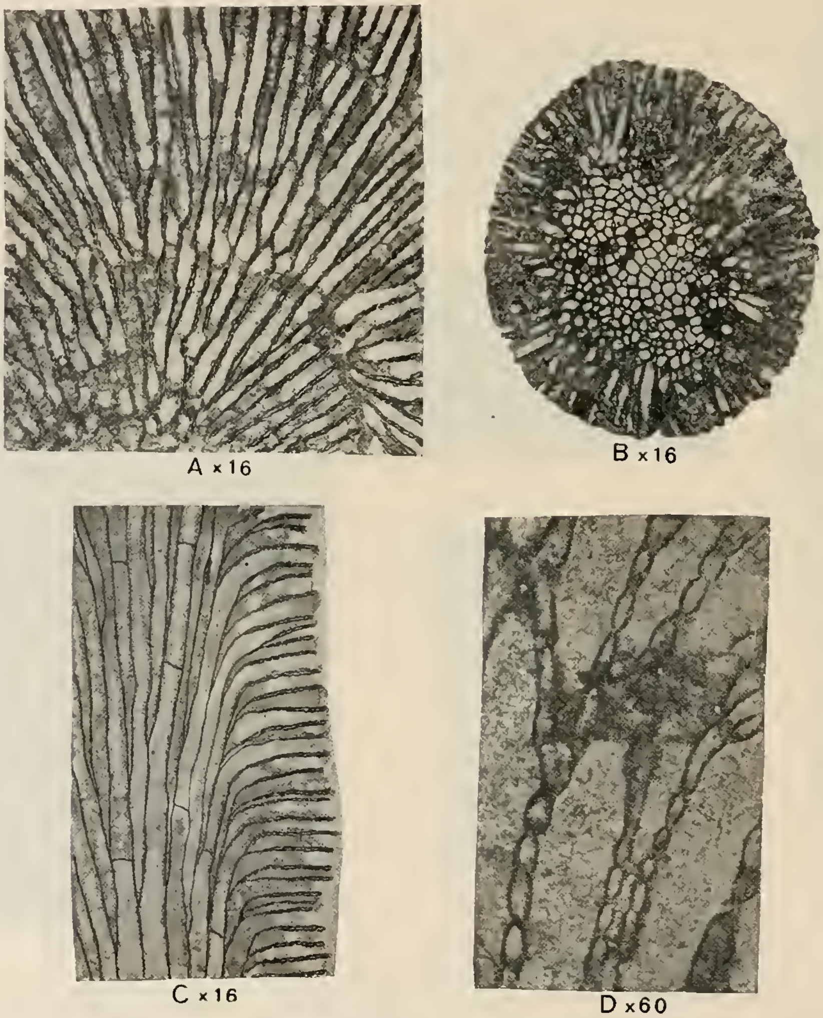

Fig. 197.—Structure of the cylindrical tubes.

A. Longitudinal thin section, × 16, of a massive species *Ceriopora vesiculosa* new species. The walls are vesicular throughout their course. B. Transverse thin section, × 16, of *Tretocycloecia dichotoma* Reuss from the Helvetian of France. The tubes are of the same size at both the center and circumference. C. Longitudinal thin section of a ramose species *Tretocycloecia reticulata* new species, × 16. The interzooecial spaces are vesicular only at the extremity of the tubes. D. Portion of longitudinal thin section, × 60, of *Heteropora constanti* D'Orbigny, showing the great size sometimes attained by the vesicles.

*Cylindrical tubes or trepostomatous-like Cyclostomata.*—In this division the inferior part of the tube is developed, but this part is very short. These tubes are parallel to each other and their length is unlimited. They give rise easily to adventitious tubes.

In transverse section all such tubes appear of the same size at the center as at the periphery; the smaller tubes dispersed irregularly between the large ones are the young tubes (fig. 197 B).

In longitudinal section the interzooecial spaces are generally vesicular throughout their course in the massive forms (fig. 197 A), but only at their extremity in the ramose forms (fig. 197 C). However there are numerous exceptions to this. These vesicles are sometimes quite large (Fig. 197 D); we are ignorant of their function. There is no zone of growth visible, since the tubes have the same diameter.

The ancestrular tubes are short and not strictly parallel to each other. They rise more or less in a spiral around the ancestrula and form the nuclear region, with nonoriented tubes (=immature region of the Trepostomata) (fig. 197 A).

*Club-shaped tubes or typical Cyclostomata.*—These increase regularly in diameter during the greater part of their length. They are slightly oblique to each other and always have a part at the exterior of the zoarium. Their length is limited. They rarely give rise to adventitious tubes. They become cylindrical when near the zone of growth or when they bend toward the exterior, or finally when they curve at a right angle with production of adventitious tubes. The last case is without exception.

In transverse section these tubes appear smaller at the center than at the circumference (fig. 198 A, B). In longitudinal section they are separated generally by a linear space, rarely vesicular (fig. 198 C).

The zone of growth is the ensemble of the small orifices of the incompletely developed tubes; it is quite variable in form and size (fig. 198 D, E). The lamella on which the new tubes are developed is called the basal lamella (=germinal lamella of D'Orbigny).

*Tubes with facets* (*Metopoporina*).—These are expanded tubes in which the peristome is closed by a facet (D'Orbigny) or zooecial area (Levinsen). This area (fig. 199) is perforated by an orbicular or semilunar orifice destined for the passage of the tentacles. The orifice is often closed by a sort of calcareous operculum. The zooecial walls are thickened at their extremity.

This form of tubes has completely disappeared from the recent seas; they correspond therefore to some anatomical features rather difficult to reestablish. Such a form exists in many families: Meliceritididae, Lobosoeciidae, Plagioeciidae, and other families.

*Tubes with rhomboidal orifice.*—These are cylindrical or funnel-shaped. Their aperture is oblique to the zooecial axis; it is not orbicular, but is elongated and rhomboidal (fig. 200). The bundles are caused by the reunion of many tubes and form zoarial and lateral expansions symmetrically arranged, called pinnules. They comprise many genera of the family Cytisidae. This form of tubes has disappeared from the recent seas.

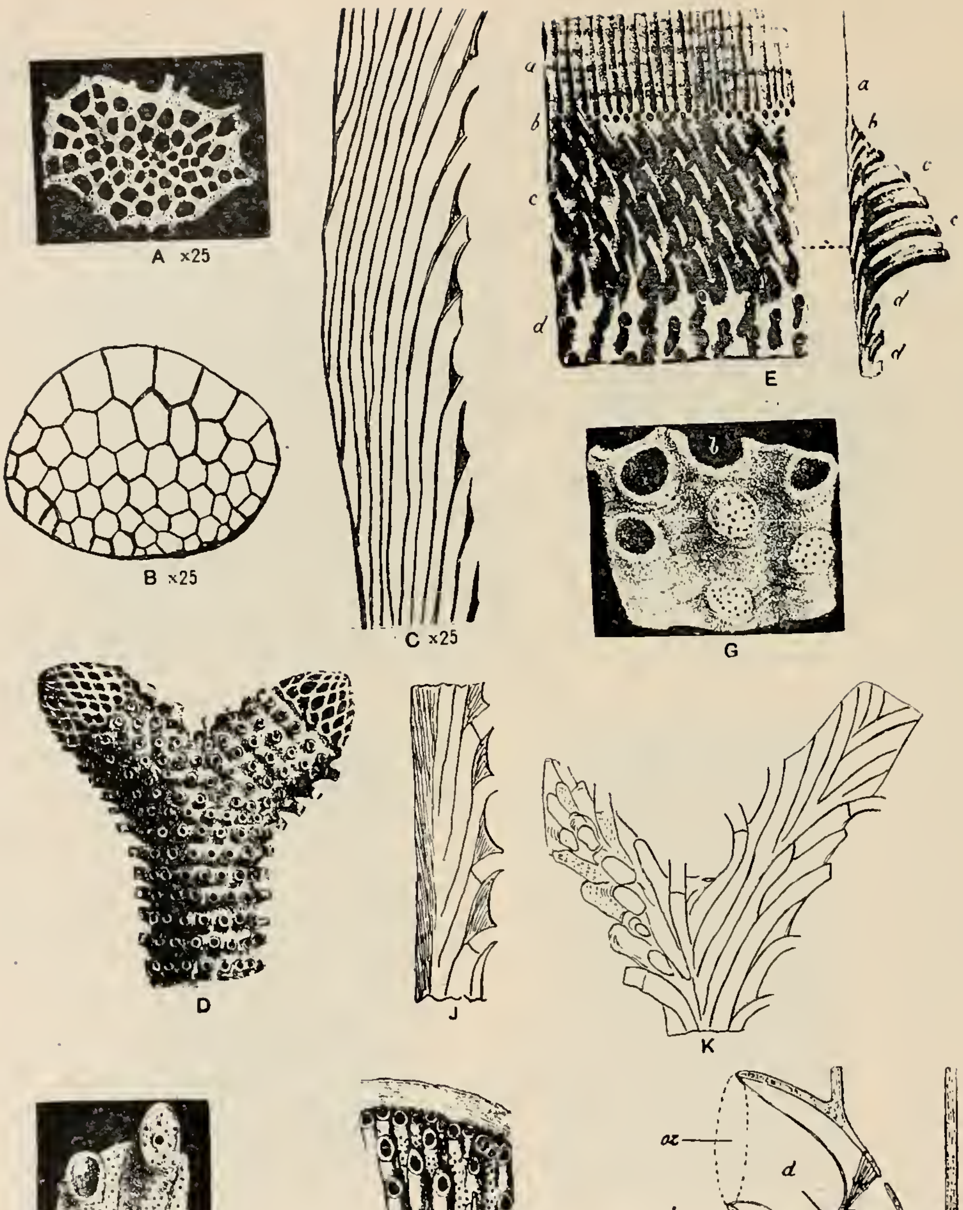
A ×25
B ×25
C ×25
a
b
c
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Fig. 198.—Structure of the tubes and apertura.

Fig. 198.—Structure of the tubes and apertura.

A. Transverse section, × 25, of *Mecynoecia cornuta*, new species, a species with club-shaped tubes. These appear smaller at the center. B. Transverse section, × 25, of *Idmonea magna*, new species, with the tubes smaller at the center of growth, here laterally placed. C. Longitudinal thin section of *Idmonea magnireversa*, new species, × 25, showing linear space separating tubes. D. A branch of *Entalophora cenomana* D'Orbigny, enlarged, showing zone of growth. E. The zone of growth and basal lamella of *Plagioecia (Diastopora) latomarginata* D'Orbigny. F. Sketch showing relations of tentacular sheath and zooecial walls in a cyclostomatous bryozoan (after Calvet, 1900); *oz*, zooecial orifice; *d*, diaphragmatic orifice; *gt*, subdiaphragmatic region of the tentacular sheath; *gt'*, super diaphragmatic region of the tentacular sheath; *mupd*, parietal diaphragmatic muscles; *t*, tentacles. G. Surface of *Plagioecia prolifera* Busk, with orifices closed by finely perforated lamella. H. Surface of *Mesenteripora meandrina* Busk, 1875, showing lamella perforated at the middle. I. *Plagioecia sarniensis* Hincks, 1880, illustrating lamella surmounted by a projecting tubule. (Figs. H–J after Busk.) J. Longitudinal thin section, × 12, of *Hornera concatenata* Reuss showing deeply placed lamella. K. Section of *Mecynoecia rugosa* Waters, 1877, illustrating that the lamella is placed where the tube rises free from the zoarium. L. Section of *Ascosoecia lateralis* D'Orbigny preserving a double lamella. (J–L after Waters.)

*The orifice or apertura.*—The orifice of the zooecial tubes is always open. Figure 198 F represents the relations of the tentacular sheath and of the walls of the zooecia in their superior or distal region.[1] It is therefore by turgescence that the polypide may extrude or retract its tentacles.

When the polypide dies from disease or accident, a calcareous lamella immediately closes the tube. This lamella is superficial and finely perforated (fig. 198 G) and varies much in form and position. It is sometimes perforated at the middle (fig. 198 H) or surmounted by a projecting tubule (fig. 198 I). Again it may be deep and invisible; it is formed then about the point where the zoarial tube rises free from the zoarium (fig. 198 J, K). It is sometimes double (fig. 198 L).[2]

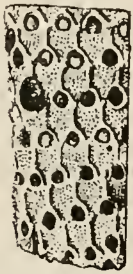

FIG. 199.—Tubes with facets.

*Loboscoecia (Meliceritites) semiclausa* Michelin from the Cenomanian at Le Mans, France, × 14. Surface of branch showing zooecia with facets.

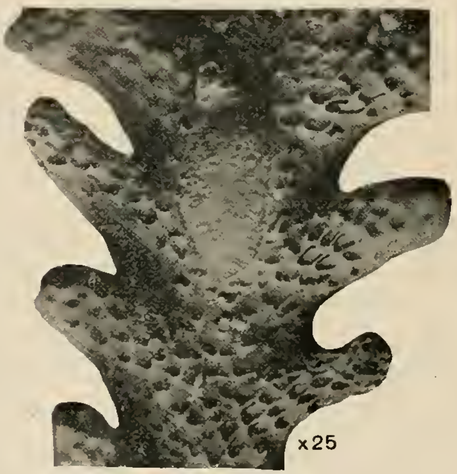

FIG. 200.—Tubes with rhomboidal orifice.

An ovicelled specimen of *Homocosolen gamblei* Gregory, 1909, × 25, from the Turonian at St. Calais, France, illustrating rhomboidal form of apertures.

*Diaphragms.*—The diaphragms are rare and accidental in the club-shaped tubes, but are abundant and specific in the cylindrical; they are sometimes formed in both the accessory and the adventitious tubes. Their physiologic function is unknown.

Like the lamellae of closure they are entire or perforated; the perforation is central or excentric. Figure 201 A, B will be useful in the interpretation of thin sections. In our American Tertiary formations species with diaphragms are rare.

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[1] 1900. Calvet, Histoire naturelle des Bryozoaires ectoproctes, p. 180, fig. 24.

[2] 1884. Waters, Closure on the Cyclostomatous Bryozoa, Journal Linnean Society, p. 400, 404, pl. 17

## ACCESSORY TUBES.

These are the zooecia closed or open which appear deprived of polypide. They may occur on the dorsal (tergopores, firmatopores, nematopores) or on the frontal (dactylethrae, cancelli).

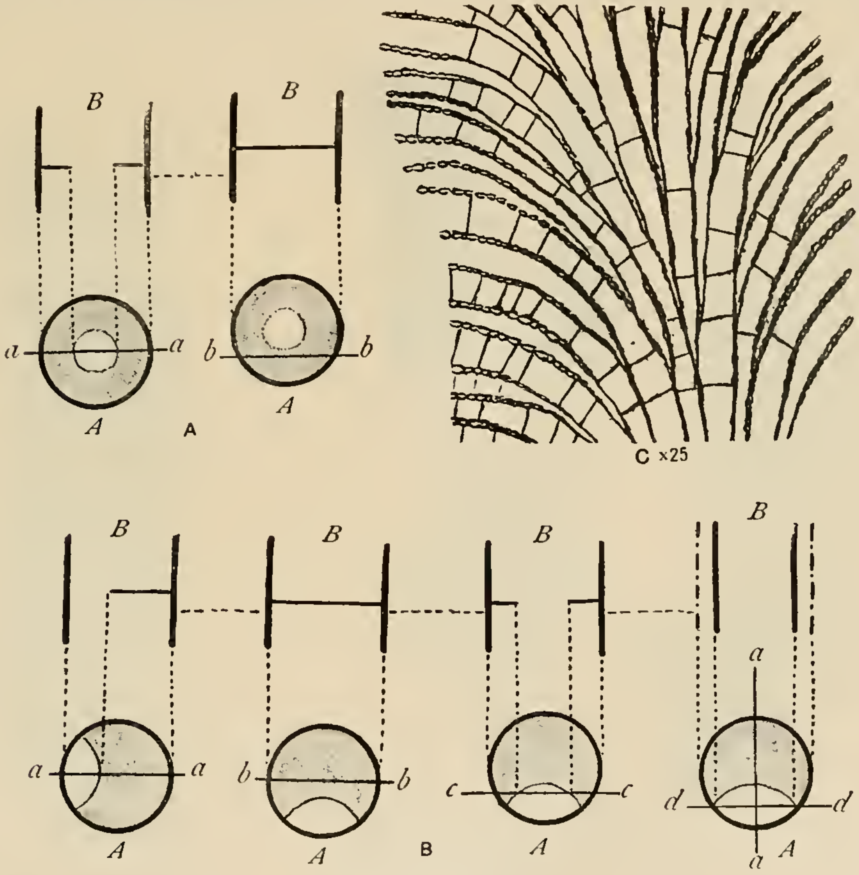

FIG. 201.—Diaphragms.

A. Sketches showing aspect where a zooecium with a centrally perforated diaphragm is cut longitudinally (*B*) and transversely (*A*); *aa* and *bb*, intersection of the two longitudinal sections. B. Sketches showing aspect where zooecium with a laterally perforated diaphragm is cut longitudinally (*B*) and transversely (*A*). C. Longitudinal thin section of *Heteropora alveolata* new species, × 25, with more numerous diaphragms than usual in the genus.

*Tergopores.*—The tergopores are ascending, transverse, accessory pores on the dorsal which are parallel to each other and as large as the polypidian tubes. They emanate from each other by successive bifurcations of their walls which are never adjacent; the new tergopores therefore always commence by the spreading of two neighboring walls. They are formed, first, of a longitudinal end portion somewhat oblique, and club-shaped, and as short as it is distant from the polypidian tubes; second, of a large, transverse, and cylindrical part. The orifice on the dorsal of the zoarium is polygonal and on fossils always open.

When a tergopore is aborted (fig. 202 A), it is immediately replaced by two others, formed by the simultaneous bifurcation of the distal and proximal tergopores.

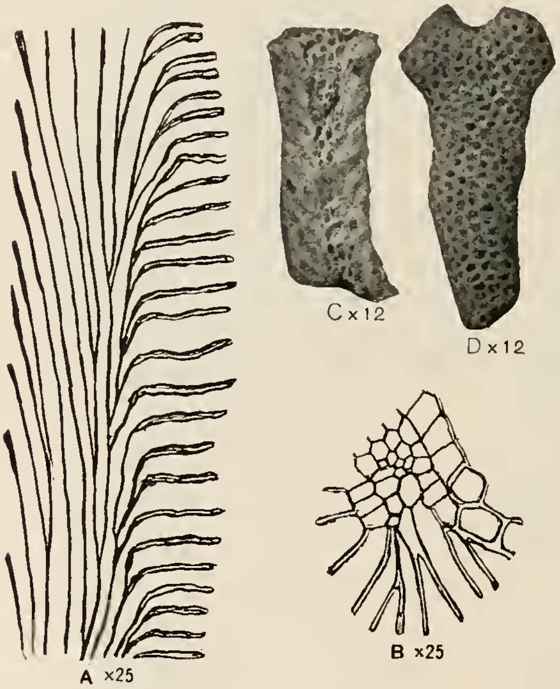

Fig. 202.—Tergopores.

A. Longitudinal thin section of *Mesonea subpertusa*, new species, × 25, illustrating structure of tergopores (to right) and zooecial tubes. B. Transverse section, × 25, of the same species showing the zooecial tubes in the upper half and the tergopores below. C. Broken branch of same, × 12, with the layer of the tergopores separated from the zooecial tubes. D. Dorsal of same, × 12, exhibiting large tergopores.

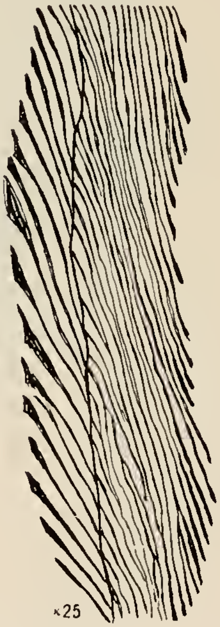

Fig. 203.—Firmatopores.

Longitudinal thin section of *Idmidronea coronopus* Milne Edwards, 1838, illustrating structure of firmatopores (to right).

The ectocyst of the tergopores was much thicker than that of the polypidian tubes, for its disappearance shows a much larger, interzooecial space (fig. 202 A).

As the tergopores give rise to one another independently of the polypidian tubes, their ensemble is easily separated from the frontal of the zoarium (fig. 202 C). They evidently form part of the system of basal fixation of the zoarium. In sections, they have the appearance of mesopores but they differ in their formation for these are tubes and not ramifications.

The tergopores have so far been observed only in the genera *Mesonea* and *Pleuronea.*

*Firmatopores.*—The firmatopores (=canal of reenforcement of Pergens) are longitudinal, cylindrical, capillary tubes on the dorsal of the zoarium. They arise on the basal lamella at all heights and are directed toward the base in the opposite direction to the zooecia which are ascending; they form by their opening on the substratum, the basal system of fixation of the zoarium (fig. 203).

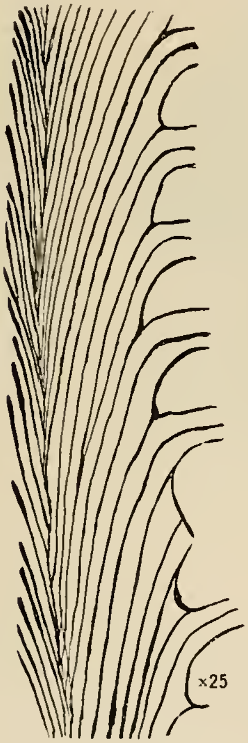

Fig. 204.—Nematopores.

Longitudinal thin section, × 25, of *Diplodesmopora opposita* new genus and species from the Coniacian at Tours, France, showing zooecial tubes to right and nematopores to left.

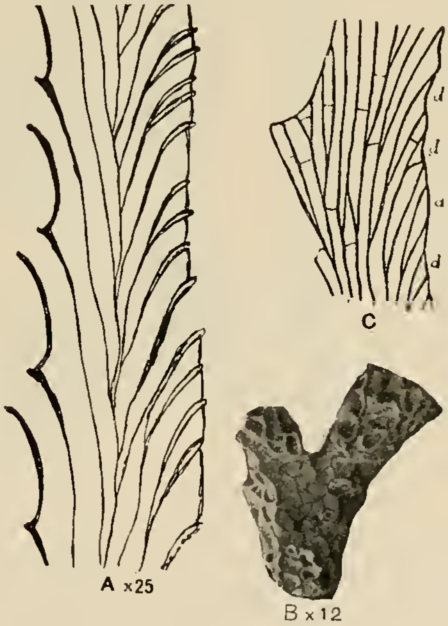

Fig. 205.—Dactylethrae.

A. Longitudinal thin section of *Erkosonea semota* new species, × 25, showing dactylethrae (to right) and zooecial tubes. B. Dorsal of the same species, × 12, illustrating dactylethrae closed by a lamella. C. Longitudinal thin section of *Clausa heteropora* D'Orbigny, showing dactylethrae (to right) and zooecial tubes.

*Nematopores.*—The nematopores are inferior and opposite ramifications of the oriented tubes; they are always rectilinear and their orifice is oblique. Their walls are thin or thick, but always adjacent. They are sometimes closed by a calcareous epitheca (fig. 204). They are distinguished from firmatopores, which have the same threadlike aspect, in their ascending and not descending arrangement.

*Dactylethrae.*—The dactylethrae are club-shaped tubes without polypide, with the same diameter as the polypidian tubes; their orifice is polygonal and closed by a calcareous lamella very finely perforated (fig. 205). They resemble the tergopores in longitudinal sections but they differ in their calcareous closure. Exteriorly the dactylethrae resemble cancelli but differ from them in longitudinal section, in their club-shaped cylindrical form, and in the absence of internal spinules. They differ from the tergopores in their aspect which is oblique and not at right angles, and in their calcareous closure.

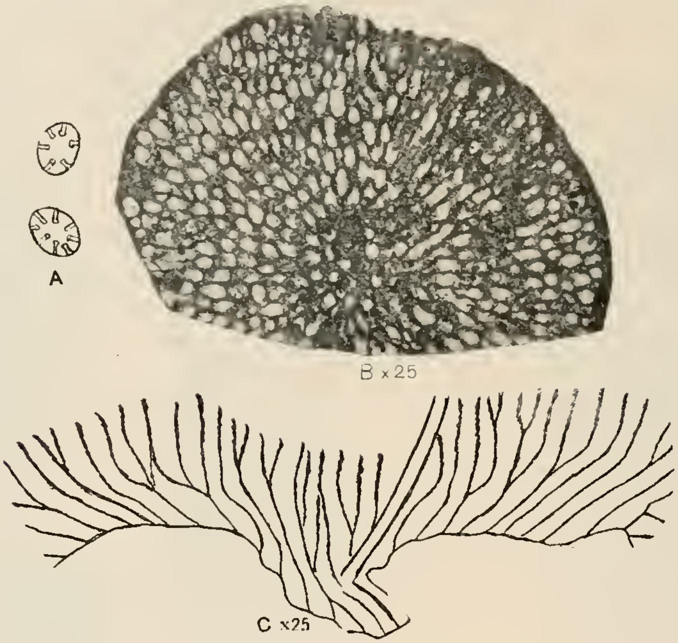

FIG. 206.—Cancelli.

A. Transverse thin sections, × 35, of two cancelli of *Lichenopora holdsworthi* Busk, 1875, showing spinules of the interior. (After Waters, 1894.) B. Tangential thin section of the dorsal, × 25, of *Lichenopora grignonensis* Milne Edwards, 1838. C. Longitudinal thin section, × 25, of *Lichenopora goldfussi* Reuss, 1864. The cancelli are superposed and ramified.

The physiological function of the dactylethrae is unknown.

*Cancelli.*—The cancelli have been interpreted in many different ways,[1] but following the principle of least change we have adopted the meaning held by the zoologists. They are the cylindrical tubes closed by a finely perforated calcareous lamella, which are garnished in the interior with numerous spinules. At the center of the zoaria the cancelli are completely cylindrical; on the margins their lower part is club-shaped (fig. 206).

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[1] For their history see Gregory, Catalogue Cretaceous Bryozoa, vol. 1, p. 12; vol. 3, p. xx.

### ADVENTITIOUS TUBES.

These are ramifications of the polypidian tubes and arise only on the frontal part of the latter. This difference is fundamental and permits no confusion. The adventitious tubes are classed as vacuoles and mesopores.

*Vacuoles.*—The vacuoles are parietal perforations with nonadjacent walls between them. They open at the base of longitudinal furrows called *sulci* and bend outward at a right angle. Vacuoles seem to characterize the family Horneridae (fig. 207), although they have been noted in at least one other family (Ascosoeciidae).

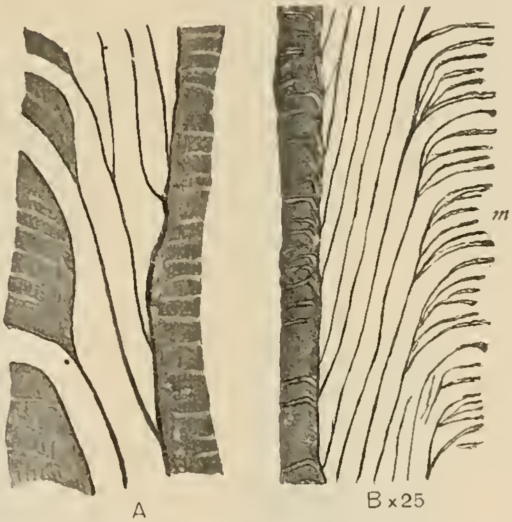

Fig. 207.—Vacuoles.

A. Longitudinal thin section, × 25, of *Hornera antarctica* Waters, 1904, showing vacuoles on both the frontal (to the left) and dorsal (to the right). B. Longitudinal thin section, × 25, of *Polyascosoecia coronopus*, new genus, and species showing difference between the vacuoles (on the left) and the mesopores (*m*) (to the right).

*Mesopores.*—The mesopores are superior and cylindrical ramifications of the bent tubes; they are without polypide and are always parallel to the superior part of the tubes. In the club-shaped zooecia their walls are generally simple (= maculae, cancelli, of Gregory) (fig. 208 C), but on cylindrical zooecia their walls are usually vesicular (fig. 208 A). However, there are numerous exceptions to this. Mesopores are almost always of smaller diameter than the generative tubes; they seem to be almost always closed by a very fragile calcareous lamella little resistant to fossilization, and finally they may branch among themselves (fig. 208 D).

Ulrich, the author of the word *mesopores*, defined them in 1890 as "angular or irregular cells occupying interzooecial spaces in certain Paleozoic genera." The accessory tubes, like the adventitious tubes, are included in this definition in spite of their difference in origin and probably function. In 1896 Gregory defined them more precisely as "aborted zooecia, which are smaller in diameter than the normal zooecia," and in 1899 as "rudimentary zooecia."

Aborted or nonaborted, a zooecium is a zooecium; it should have the same origin as a polypidian zooecium and should grow from another zooecium by a special mode of gemmation and before its complete calcification. Any cellular cavity not having this origin is not a zooecium (=tube) but is only a ramification. This consideration of origin obliges us therefore to change the nomenclature somewhat. Two solutions are possible, first, to preserve Ulrich's definition and apply the term "mesopore" to all structures which are not polypidian tubes in conformity with the ideas of the author, or second, to restrict it to the zooecial ramifications only.

In the first alternative we would be obliged to create a new work for the zooecial ramifications which would change the description of most of Ulrich's genera and species. In the second, on the contrary, very few descriptions would have to be changed. By application of the principle of least change we have thought that the restriction of the term "mesopore" to zooecial ramifications would be preferable

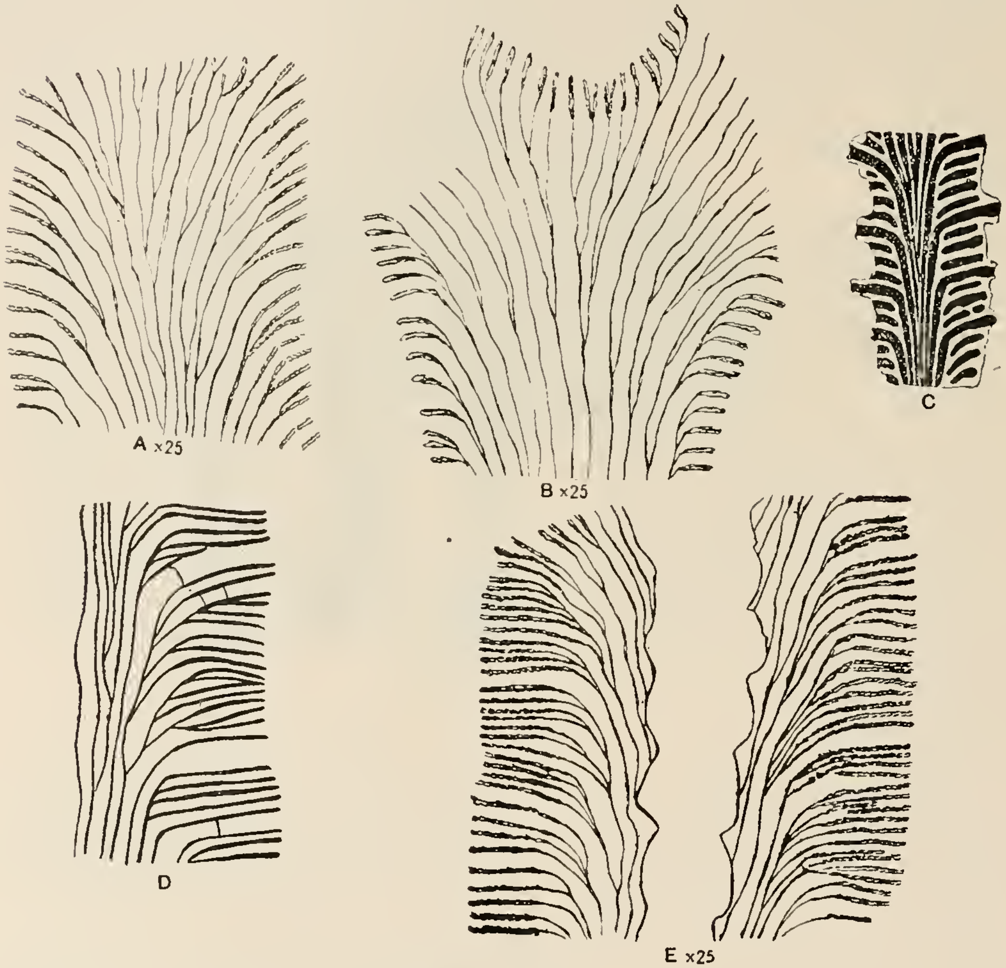

Fig. 208.—Mesopores.

A. Longitudinal thin section, × 25, of *Tretocycloecia ? attenuata* Ulrich, 1882. The mesopores are short and few. B. Longitudinal thin section, × 25, of *Heteropora ovalis* new species. The mesopores are very short. C. Longitudinal section of *Sparsicavea carantina* D'Orbigny. (After Gregory.) The zooecia are club-shaped and the walls are simple. D. Longitudinal section of *Ascosoecia* (*Zonopora*) *arborea* Koch and Dunker, 1837. (After Pergens, 1899.) The mesopores are ramified. E. Longitudinal section of *Parleiosoecia jacksonica*, new species, × 25, showing branching mesopores with vesicular walls.

## GEMMATION.

In principle, gemmation is independent of the form of the tubes and their reunion in bundles. Gemmation may be divided into juxtaposed, peripheral, or oriented.

In juxtaposed gemmation the tubes are parallel and open at their two extremities. In transverse section, they are larger at the center of the zoarium. Such gemmation exists only in the family Corymboporidae, which became extinct in the Cretaceous (fig. 209 A).

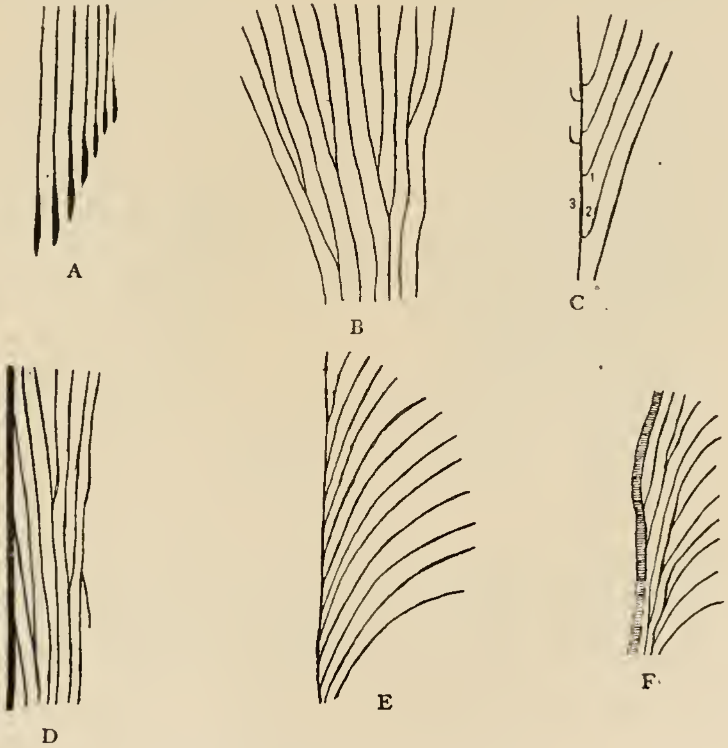

Fig. 209.—Methods of gemmation.

Sketches showing (A) juxtaposed, (B) peripheral, (C) triparietal, (D) intrazoarial, (E) dorsal, and (F) axial methods of gemmation.

Peripheral gemmation results from the bifurcation of the tubes at all heights and in all directions. It is observed most frequently in bryozoa with cylindrical tubes, (Trepostomata, *Ceriopora*), but it has been noted in genera with other forms of tubes (*Ceriocava*).

Oriented gemmation occurs in a definite manner on a single or on two sides of a basal lamella or of an axial zone. It is triparietal or biparietal.

In triparietal gemmation each tube in longitudinal section is, at its base, adjacent to three other tubes. The latter are always short. This kind of gemmation characterizes the Cryptostomata, but it has also been noted in many different families of the Cyclostomata and with varied forms of tubes, cylindrical (*Cyrtopora*, *Grammascosoecia*, *Crisina*) or funnel-shaped (*Cea*).

In biparietal gemmation the tubes in longitudinal section are, at their base, adjacent to two other tubes. It is dorsal, axial, or intrazoarial.

Dorsal gemmation occurs on the basal lamella. The tubes grow on the dorsal, one from the other, early, before the formation of the polypide; the zone of growth is visible and regular. The expanded tubes adopt chiefly this mode of gemmation (zoarial forms called *Entalophora*, *Berenicea*, etc.) in a large number of families.

Axial gemmation occurs by bifurcation in the vicinity of the zoarial axis. The zone of growth is visible but irregular. It has no basal lamella, but there is almost always an opposite plane formed of adventitious zooecia (*Reteporidea*, *Desmeopora*, *Oseulipora*).

Intrazoarial gemmation occurs at all heights and at all places in the interior of the zoarium. The dorsal of the zoarium is not a basal lamella; it is formed by the reunion of the tubes coming from the interior of the zoarium (*Frondipora*). There are all stages between axial gemmation and intrazoarial gemmation. In tabular form gemmation is therefore as follows:

By juxtaposition.
Peripheral.
Oriented----
    Triparietal.
    Biparietal----
        Dorsal.
        Axial.
        Intrazoarial.

ZOARIUM.

*Form.*—The form of growth in the Cyclostomata is quite variable and the number of zoarial forms known is quite large. Generally the same species always assumes the same zoarial form. Each form of growth has a particular name, and in the old classification they constituted many distinct genera. The reader will find these zoarial forms described in great detail in Gregory's Catalogue of the Cretaceous Bryozoa.

*Basal system of fixation.*—The basal system of fixation of the free zoaria is little known. This is an absolutely new study to be undertaken when sufficient material has been collected. The scarcity of such specimens has prevented us from attempting this study. Certain accessory dorsal tubes undoubtedly form part of the system of fixation and it will be useful to know their reciprocal relationships.

*Growth.*—The growth of the zoaria when there are no mesopores occurs:

1. By zooecial superposition, if the tubes are cylindrical.
2. By indefinite zooecial multiplication if the tubes are club-shaped.
3. By superposition or agglomeration of subcolonies.

The growth of the zoaria with mesopores is difficult to understand; the section of a small zoarium is identical with that of a large one. It is necessary therefore to suppose that the animal constantly recommences its tube. This consideration had induced Lee[1] to formulate his theory of reabsorption which is summarized in figure 210.

*Branching.*—Branching of a zoarium is not a spontaneous accidental or rapid phenomenon in close relationship with the mechanical movements of the water, but is a true physiological phenomenon. Its object is the increase of the zoarial surface, that is in reality, the surface of oxygenation. Moreover, as seen in sections (fig. 211), the divergence of the axial tubes of ramification begins early, almost at the base of the primitive branch.

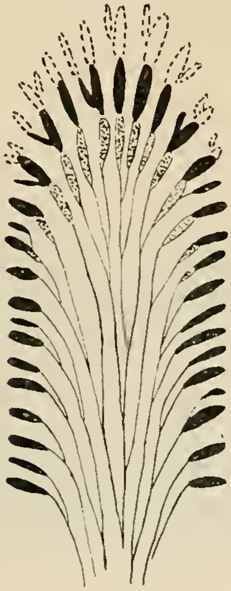

Fig. 210.—Growth of zoarium.

Diagram of a branching trepostomatous bryozoan showing in black the colony as seen in longitudinal section, in stippling the terminal portion of the same during an earlier period and supposed to have been resorbed, and in broken lines, the terminal portion as it might have been had growth continued. (After Lee, 1912.)

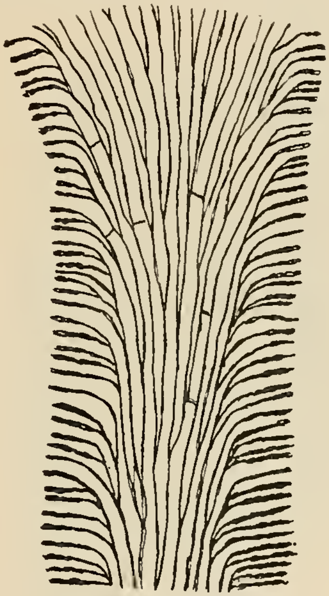

Fig. 211.—Branching of zoarium.

Longitudinal thin section of *Tretocycloecia reticulata* new species, × 12, showing that the separation between the two axial tubes of ramification occurred near the base of the cylindrical branches.

The necessity of the dichotomous, arborescent, or bushy architecture requires the formation of accessory tubes of padding and of consolidation; they often oppose the free development of the poorly placed zooecia, the degenerate polypide of which and the orifice are closed by lamellae.

During the Paleozoic era the atmospheric pressure may have been greater and consequently the quantity of oxygen dissolved in the sea water was greater. In the following eras the rarification of the oxygen has caused an increase in the number of the ramified species, the symmetry of the zoaria, and the diminution of the adventitious tubes.

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[1] 1912. Lee, British Carboniferous Trepostomata, pl. 14, fig. 3, p. 144.

*Origin of the zoarium.*—The first tube of a zoarium is the ancestrula and its lower part is a dilated blisterlike form called the protoecium. It is in this dilation that (1) the histolysis of the fixed larva and (2) its replacement by the first normal polypide living in the ancestrula occurs.

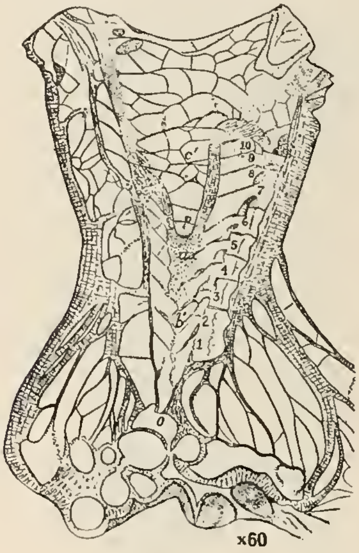

Fig. 212.—Origin of zoarium.

Section of a *Fenestella*, × 60, cutting exactly in the plane of the axis and of the zooecial apertures to the right (1–10). The initial zooecium (protoecium) is at *o*; the thickening of the axis (*ax*) commences at *b′*; the apex of the cone of expansion of the colony is at *p*; the vesicular tissue (*c′*) above *p* is of secondary origin forming during the mature and senile life of the colony. (After Cumings, 1904.)

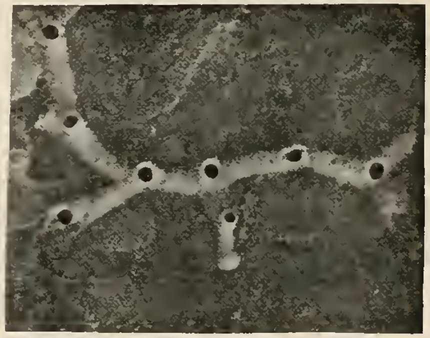

Fig. 213.—Protoecium.

Zoarium, × 25, of *Stomatopora parvipora* new species, showing the orbicular protoecium.

The protoecium is visible on all incrusting species in which the zoarial form is that of *Proboscina* or *Berenicea* (fig. 213). In the free species it is visible only in the section properly made in the base of the zoarium (fig. 212). The scarcity of specimens has not allowed us to make a special study[1] of this feature.

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[1] The reader will find excellent models in the studies of Cummings.

1904. Development of some Paleozoic Bryozoa, American Journal of Science, pp. 49–78, with 83 figures.

1905. Development of Fenestella, American Journal of Science, pp. 169–178, 3 pls.

1905. Development and Systematic Position of the Monticuliporoids, Proceedings of the Paleontological Society, vol. 23, pp. 357–366, with plates.

### OVICELLS.

The ovicells of the cyclostomatous bryozoa are usually rare. Moreover, they are very fragile and resist fossilization very poorly. Their form and nature give the essential characters of an entirely natural classification. This new conception has obliged us to greatly modify and correct the zoarial classification hitherto generally recognized.

The ovicells allow the larva to escape by an orifice called the oeciopore, which is surrounded by a more or less salient collar called the oeciostome. In another group the escape of the larva occurs by the rupture of the walls and there is no oeciostome.

The studies concerning the ovicells of the fossil bryozoa are still very incomplete; it is often impossible to discover the oeciostome on a single specimen and consequently to find a good generic character immediately. The special mode of formation of the larva is the cause of this rarity of the ovicells. The fertile egg is developed by successive segmentation into a large primary embryo occupying almost all the ovicell. In the latter, by fissiparity secondary embryoes are detached which are evolved in the ordinary manner and escape by the oeciostome. In this manner 150 larvae may be sent out from a single ovicell (fig. 214).

Figure 226 gives the form of the ovicell in each family discussed in this volume.

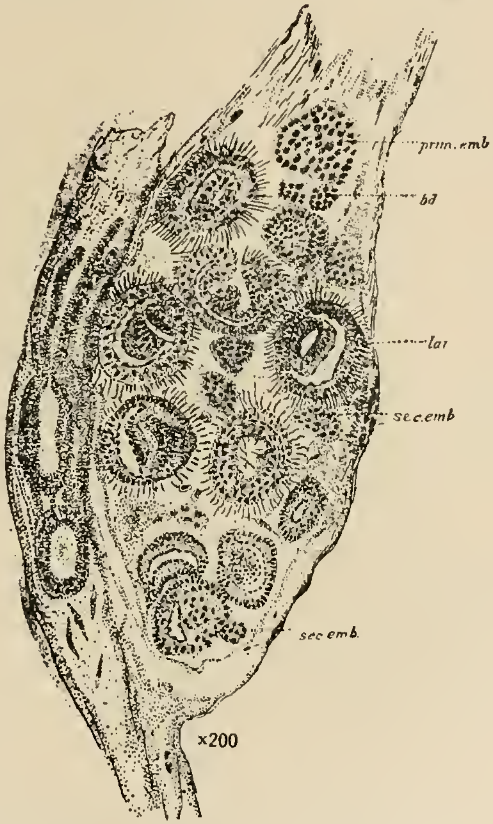

Fig. 214.—Fissiparity of primary embryo. Section of a mature ovicell of *Crisia eburnea* Linnaeus, 1758, × 200, showing the primary embryo (*prim. emb*) giving off buds (*sec. emb*) and also larvae (*lar*). (After Robertson.)

### SYSTEMATIC DESCRIPTION OF THE CYCLOSTOMATA.

Our studies have caused us to reject for the present all of the former major classifications of the Cyclostomata and to retain simply for convenience the two larger divisions of the Inovicellata and Ovicellata. Under the first of these terms we recognize two subdivisions (*a*) the typical Cyclostomata, or those with club-shaped tubes and (*b*) trepostomatous-like Cyclostomata, or those with cylindrical tubes.

## Division INOVICELLATA

### (a) TYPICAL CYCLOSTOMATA

### Family DIASTOPORIDAE Gregory, 1899.

Cyclostomata tubulata in which the zooecia are simple, open tubes, which either grow as linear series or as incrusting or erect sheets. The sheets may be coiled into hollow tubes. The zoarium is exceptionally massive. The zooecia may be wholly immersed or partly free. Appendages absent. (After Gregory, 1899.)

#### Forma STOMATOPORA Bronn, 1825.

1825. *Stomatopora* Bronn, System Urweltlichen Pflanzenthiere, p. 27, pl. 7, fig. 3.

1896. Gregory, Catalogue of the Jurassic Bryozoa in the British Museum, p. 42.—1904. Lang, The Jurassic Forms of the Genera Stomatopora and Proboscina, Geological Magazine, ser. 5, vol. 1, pp. 315–322.—1905. Stomatopora antiqua Haime and its related Liassic forms, Geological Magazine, ser. 5, vol. 2, pp. 258–268.—1907. The evolution of Stomatopora dichotomoides, Geological Magazine, ser. 5, vol. 4, pp. 20–24.

Zoarium flat, adnate, branching dichotomously, composed of uniserial subtubular zooecia.

*Genotype.*—*Stomatopora dichotoma* Lamouroux, 1821.

*Range.*—Ordovician-Recent.

The tubes are oval when the peristome is of less width than the width of the tubes. They are cylindrical when the diameter of the peristome and of the tube is practically equal. Again there are some fusiform tubes and others having a club shape. The peristomie is the free part of the tubes forming a prominence above the general zoarial surface; in the fossil forms it is never very large. The peristome is always round; it remains so when the peristomie is perpendicular to the zooecial plane. Most of the time the peristomie is oblique and by rupture the peristome becomes elliptical.

In our descriptions we never give the size of the aperture. This is a measurement which is absolutely inconstant on the same zoarium and the consideration of the diameter of the peristome appears to us sufficient. The determination of species of *Stomatopora* and of *Proboscina* is extremely difficult. A knowledge of the ancestrula would probably make the work less difficult, but unfortunately no study of this part of the subject has yet been made.

The genus *Stomatopora* has been the subject of much study by Lang, who has established the following points:

> The development of a zoarium is comparable with and follows the same laws as the development of the zooecium.
>
> In the genera *Stomatopora* and *Proboscina* the method of branching is of paramount importance.

Two ways of branching may be noticed, namely, lateral branching (ramification) and dichotomy (dichotomisation).

> In lateral branching a new zooecium arises from any point in a chain of old zooecia, and generally diverges at a wide angle (see diagram 2, fig. 1, fig. 215B).

In dichotomy, two new zooecia arise from the end of an older zooecium; the angle at which they diverge varying from 180° to 20° or 30°, and varying in a definite manner (see diagram 2, figs. 2–9).

Dichotomy in the forms under consideration occurs in three types, one of which is intermediate between the other two. In that termed type I the two new zooecia are separate from one another throughout their whole length (diagram 2, figs. 2, 3, 9), only touching at their bases. In type 2 they are contiguous throughout their length (figs. 4, 5, 8); and they are contiguous for part of their length in the intermediate type (figs. 5, 6, 7). The angle of divergence of the two new branches tends to diminish distally.

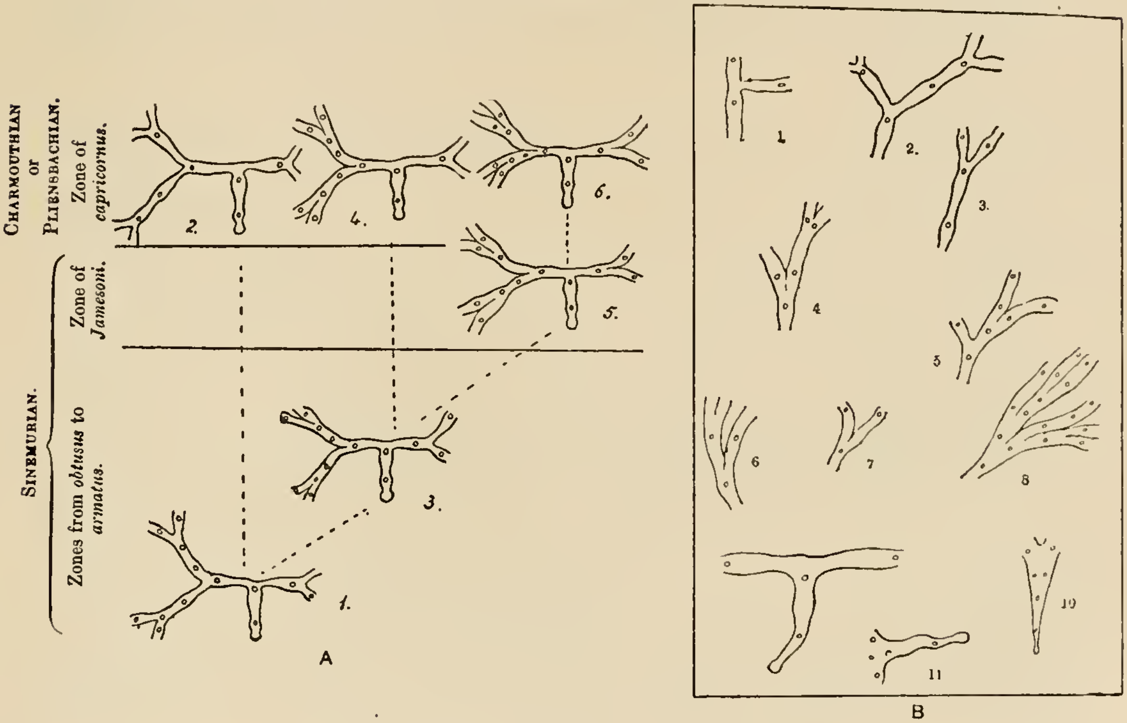

FIG. 215.—Forma *Stomatopora* Bronn, 1825.

A. Diagram to show the changes in the method of branching and in the shape of the zooecium in *Stomatopora antiqua* Haime and its related Liassic forms. B. Diagram showing the method of branching in Jurassic forms of *Stomatopora* and *Proboscina*. 1, lateral branching; 2, type I with large angle; 3, type I with small angle; 4, type II with small angle; 5, type II with large angle preceded by intermediate type with large angle; 6, intermediate type with small angle; 7, intermediate types with large angle; 8, type II with an angle of 0°; 9, type I with an angle of 180°; 10, the first dichotomy is after type II with an angle of 0°; 11, the arrangement of the peristomes is irregular from the first.

The frequency of branching is measured by the number of peristomes between two dichotomies. The number of peristomes between the first two or three dichotomies is small (nearly always one or two), then suddenly increases largely (anagenesis) and finally becomes small again (katagenesis).

The ratio of length of zooecium to breadth is progressive (anagenetic) at first and reaches its acme at the third dichotomy, after which it is retrogressive (katagenetic).

> Generally the zooecia are either cylindrical or pyriform. In many of those forms which have cylindrical zooecia throughout the greater part of the zoarium, the zooecia between the first and third dichotomies tend to be slightly pyriform; while in those forms with pyriform zooecia, the zooecia between the first and third dichotomies are generally more pyriform than the rest.
>
> Ribbing, when present, is usually faint at its first appearance, becoming stronger later on, and in some cases becoming fainter again finally. The point at which the acme is reached varies a great deal.

Finally, Lang has demonstrated that the method of branching and the shape of the zooecia varies sensibly in time and according to the successive geologic stages (fig. 215A).

In the application of these observations Lang, in order to characterize a species of *Stomatopora*, made a large table,[1] which is an excellent example of bookkeeping. We are unfortunately not able to adopt this method in our work as we do not possess a sufficient number of specimens of our various species.

Before Lang's studies, Gregory, in 1896, had also devised a system of description, which, however, was given up in the succeeding volumes of the Catalogue of the British Museum. In order to make the species collected in our American Tertiary formations of stratigraphic value we have no other method than that of good illustrations always on the same scale (×12 and ×25).

The branches of the same zoarium of *Stomatopora* or of *Proboscina* never grow over each other (see pl. 105, fig. 1); a branch is arrested in growth when it encounters another. What is the mysterious force which permits the minute branches of the same colony to be cognizant of each other in the eternal night of the oceanic depths? Evidently this is a manifestation of a kind of cerebral activity of which the nerve ganglion of the bryozoa is the organ. But how does the transmission of the sympathetic vibrations occur and by what magic do they become synchronized? Although microscopic the biologic mechanism of a zoarium is sublime.

### STOMATOPORA OPPOSITA, new species.

Plate 107, fig. 25.

*Description.*—The zoarium is not dichotomous; the branches are *opposed* and are emitted symmetrically at the distal extremity of a tube. The tubes are short, finely punctate, elliptical. The peristome is orbicular, thick, little salient.

| | | |
|---|---|---|
| *Measurements.*— | Diameter of tube | 0.36 mm. |
| | Length of tube | 0.50–0.70 mm. |
| | Diameter of peristome | 0.20 mm. |

*Occurrence.*—Midwayan (Clayton limestone): Mabelvale, near Little Rock, Arkansas (very rare).

*Holotype.*—Cat. No. 65247, U.S.N.M.

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[1] Lang, Geological Magazine, vol. 2, 1905, p. 262; vol. 4, 1907, p. 23, etc.

### STOMATOPORA CONTRACTA, new species.

Plate 105, figs. 1, 2.

*Description.*—The zoarium creeps over shells (*Terebratula*) forming irregular polygons; the dichotomization occurs almost at right angles. The tubes are oval, *contracted* at their extremity, finely striated transversely. The peristome is orbicular, thick, little salient.

*Measurements.*—

| | |
|---|---|
| Diameter of tube | 0.36 mm. |
| Length of tube | 0.50–0.60 mm. |
| Length of peristomie | 0.16 mm. |

In the specimen shown in our figure, three tubes appear to have undergone total regeneration.

*Occurrence.*—Midwayan (Clayton limestone): Well at Brundidge, Alabama (very rare).

*Holotype.*—Cat. No. 65249, U.S.N.M.

### STOMATOPORA EXIGUA, new species.

Plate 107, fig. 26.

*Description.*—The zoarium incrusts shells. The tubes are fusiform, *narrow*, striated transversally. The peristome is thin, oblique, round, or elliptical; the peristomie is very oblique.

*Measurements.*—

| | |
|---|---|
| Diameter of tube | 0.20 mm. |
| Length of tube | 0.56 mm. |
| Diameter of peristome | 0.12 mm. |
| Length of peristomie | 0.16 mm. |

*Occurrence.*—Midwayan (Clayton limestone): Well at Brundidge, Alabama (very rare).

*Holotype.*—Cat. No. 65248, U.S.N.M.

### STOMATOPORA PARVIPORA, new species.

Plate 131, figs. 8, 9.

*Description.*—The zoarium incrusts oysters and other shells. The tubes are cylindrical, *very small*, striated transversally; the protoecium is orbicular. The peristome is thin, salient, oblique, round, or elliptical; the peristomie is short.

*Measurements.*—

| | |
|---|---|
| Diameter of tube | 0.14–0.18 mm. |
| Length of tube | 0.40–0.50 mm. |
| Diameter of peristome | 0.12–0.14 mm. |

*Occurrence.*—Lower Jacksonian (Moodys marl): Jackson, Mississippi (very rare).

Middle Jacksonian (Castle Hayne limestone): Wilmington, North Carolina (rare).

Vicksburgian ("Chimney rock" member of Marianna limestone): One mile north of Monroeville, Alabama (very rare).

*Cotypes.*—Cat. Nos. 65361, 65362, U.S.N.M.

### STOMATOPORA POLYGONA, new species.

Plate 115, figs. 9–11.

*Description.*—The zoarium incrusts shells and orbitoid foraminifera on which it forms more or less regular *polygons;* the angle of dichotomization is very obtuse and close to 120°. The tubes are thin, cylindrical. The peristome is thick, round, little salient.

| *Measurements.*— | | |
|---|---|---|
| | Diameter of tube | 0.10–0.12 mm. |
| | Length of tube | 0.56–0.60 mm. |
| | Diameter of peristome | 0.10 mm. |

This very interesting species is easily recognized by its small polygonal zoaria.

*Occurrence.*—Lower Jacksonian (Moodys marl): Jackson, Mississippi (rare). Middle Jacksonian: Wilmington, North Carolina (very common), Eutaw Springs (rare), and near Lenuds Ferry, South Carolina (very rare).

Upper Jacksonian (Ocala limestone): West bank Sepulga River, Escambia County, Alabama (rare); Old Factory about 1½ miles above Bainbridge, Georgia (rare); and below Plant System Railroad Wharf, Bainbridge, Georgia (very rare).

Vicksburgian (Marianna limestone): One mile north of Monroeville, Alabama (very rare); and Salt Mountain, 5 miles south of Jackson, Alabama (rare).

*Cotypes.*—Cat. No. 65277, U.S.N.M.

### STOMATOPORA MINUTA, new species.

Plate 162, fig. 21.

*Description.*—The zoarium incrusts orbitoid foraminifera. The tubes are cylindrical, *small*, smooth. The peristome is thin, salient, elliptical.

| *Measurements.*— | | |
|---|---|---|
| | Diameter of tube | 0.10 mm. |
| | Length of tube | 0.20 mm. |
| | Diameter of peristome | 0.10 mm. |

*Occurrence.*—Vicksburgian (Marianna limestone): Murder Creek east of Castlebury, Conecuh County, Alabama (very rare).

*Holotype.*—Cat. No. 65475, U.S.N.M.

### STOMATOPORA EXCAVANS, new species.

Plate 115, fig. 1.

*Description.*—The zoarium incrusts shells, in which it appears to *excavate* furrows. The tubes are club-shaped, very narrow behind and raised almost vertically at their extremity. The peristome is thin, oblique, orbicular, or elliptical.

| *Measurements.*— | | |
|---|---|---|
| | Length of tubes | 0.48–0.50 mm. |
| | Diameter of peristome | 0.10–0.12 mm. |

*Affinities.*—This species differs from *Stomatopora cornu*, in which the tubes are also club-shaped, by its smaller micrometric dimensions.

*Occurrence.*—Middle Jacksonian (Castle Hayne limestone): Wilmington, North Carolina (very rare).

*Holotype.*—Cat. No. 65274, U.S.N.M.

### STOMATOPORA CORNU, new species.

Plate 130, fig. 14.

*Description.*—The zoarium incrusts shells. The tubes are long, in the form of a *horn.* The peristome is thick, salient, round.

| | | |
|---|---|---|
| *Measurements.*— | Length of tube | 0.80 mm. |
| | Diameter of peristome | 0.10 (0.14 mm.). |

*Occurrence.*—Upper Jacksonian (Ocala limestone): Chipola River, east of Marianna, Jackson County, Florida (rare).

*Holotype.*—Cat. No. 65455, U.S.N.M.

### STOMATOPORA PRATTI, new species.

Plate 116, figs. 1–3.

*Description.*—The zoarium incrusts bryozoa and shells, forming very irregular polygons. The tubes are oval, wide, wrinkled transversally, of quite variable width. The peristome is thin, salient, orbicular.

| | | |
|---|---|---|
| *Measurements.*— | Diameter of tube | 0.40 mm. |
| | Length of tube | 0.60–1.20 mm. |
| | Diameter of peristome | 0.22 mm. |

This species is well characterized by its great zooecial width. The specific name is in honor of Dr. J. H. Pratt, State geologist of North Carolina.

*Occurrence.*—Middle Jacksonian: Wilmington, North Carolina (common); near Lenuds Ferry, South Carolina (rare); 3¼ miles south of Perry, Georgia (very rare).

Upper Jacksonian (Ocala limestone): West bank of Sepulga River, Escambia County, Alabama (very rare); Chipola River, east of Marianna, Jackson County, Florida (very rare).

*Cotypes.*—Cat. No. 65268, U.S.N.M.

### STOMATOPORA STRIATULA, new species.

Plate 116, figs. 4, 5.

*Description.*—The zoarium incrusts shells, orbitoid foraminifera and bryozoa; the angle of dichotomization is very acute and about 60° at the most. The tubes are oval, wide, *striated* transversally. The peristome is thin, salient, orbicular, The peristomie is short. The angle of divergence is sometimes so small that two primoserial tubes are adjacent and the zoarium partially assumes the aspect of a *Proboscina.*

| | | |
|---|---|---|
| *Measurements.*— | Diameter of tube | 0.24–0.30 mm. |
| | Length of tube | 0.70–0.80 mm. |
| | Length of peristome | 0.16–0.20 mm. |
| | Length of peristomie | 0.20 mm. |

*Affinities.*—This species may be confused with *Stomatopora pratti* in its general size. It differs from it in the smallness of the angle of divergence of the branches and in its zooecial width which is never more that 0.30 mm.

*Occurrence.*—Middle Jacksonian: Near Lenuds Ferry, South Carolina (rare); Wilmington, North Carolina (rare).

Upper Jacksonian (Ocala limestone): Alachua, Florida (very rare).

*Cotypes.*—Cat. Nos. 65269, 65270, U.S.N.M.

### STOMATOPORA FASCIOLATA, new species.

Plate 116, figs. 10, 11.

*Description.*—The zoarium incrusts bryozoa, forming irregular rectangles. The tubes are oval, very wide, often ornamented with salient, transverse *bands.* The peristome is thin, round, somewhat oblique, salient.

| | | |
|---|---|---|
| *Measurements.*— | Diameter of tube | 0.50 mm. |
| | Length of tube | 0.70–1.00 mm. |
| | Diameter of peristome | 0.24 mm. |

*Affinities.*—The large species is clearly characterized by its zooecial width, which is much greater than that of *Stomatopora pratti.* The transverse bands are, moreover, very inconstant.

*Occurrence.*—Upper Jacksonian (Ocala limestone): Old Factory, about 1½ miles above Bainbridge, Georgia (very rare).

*Holotype.*—Cat. No. 65273, U.S.N.M.

### Forma PROBOSCINA Audouin, 1826.

1826. *Proboscina* AUDOUIN, Explication sommaire des planches de Polypes de l'Egypte et de la Syrie. . . . In Savigny's Description de l'Egypte. Histoire Naturelle, vol. 3, p. 236.

The zoarium consists of multiserial elongate bands, which may be simple or branched, and are always flat and adnate. The zooecia are cylindrical and narrow. The peristomes are flush with the surface of the zoarium, or slightly raised; and they are usually distributed irregularly, but are occasionally quincuncial or in transverse linear series.

*Range.*—Ordovician—Recent.

*Historical.*—*Proboscina boryi* Audouin, 1826, was the first species of this genus and has been quoted as the genotype, although the genus *Proboscina* has never been considered as more than a multiserial *Stomatopora.* Numerous species ranging from the Middle Ordovician to the Recent have been referred to the genus and for almost a hundred years it has been recognized by all authors in a zoarial sense. However, the original figures of *Proboscina boryi* showed the presence of an ovicell formed by an enlargement of the peristomie, a character which we believe of more importance that the form of growth, hitherto depended upon for the recognition of the genus. On the principle of least change we believe it best to retain the name *Proboscina* for the many multiserial incrusting species in which the ovicell is unknown and to refer the few ovicelled species elsewhere. In this case *Proboscina boryi* becomes a member of the new genus *Peristomoecia* described on page 692.

The bi- and tri-serial species of *Proboscina* have a family likeness, which renders them easily discernible. A single ovicell was figured by Waters in 1904 and it is known in another Cretaceous species in the Canu collection.

The multiserial species of *Proboscina* are quite variable in their development. Many ovicelled species are known, and, as indicated elsewhere in this work, they belong to different genera and even different families.

*Terminology.*—This is the same as that of *Stomatopora.* We add only the maximum width of the zoarium, and sometimes the separation of the tubes. The latter is measured by the distance between two tubes placed at the same height, their peristome being included in the measurement (see text figure 216).

### PROBOSCINA VARIABILIS, new species.

Plate 105, figs. 3, 4.

*Description.*—The zoarium is biserial and incrusts shells. The tubes are oval, smooth, alternately arranged. The peristome is thick, round, salient; the peristomie is short, almost perpendicular.

| | | |
|---|---|---|
| *Measurements.*— | Maximum width of zoarium | 0.32 mm. |
| | Length of tube | 0.50–0.60 mm. |
| | Diameter of peristome | 0.12–0.14 mm. |
| | Length of peristomie | 0.16 mm. |

*Occurrence.*—Midwayan: (Claxton limestone). Well at Brundidge, Alabama (very rare).

*Holotype.*—Cat. No. 65250, U.S.N.M.

### PROBOSCINA ADMOTA, new species.

Plate 105, figs. 7–11.

*Description.*—The zoarium is multiserial and incrusts shells or algae; it is formed of thick, claviform fronds, bifurcated and not ramified, more or less symmetrically arranged on each side of the ancestrula. The tubes are indistinct and arranged in transverse series. The peristomie is thin, salient, orbicular. The peristomes are very *close* to each other.

| | | |
|---|---|---|
| *Measurements.*— | Maximum width of zoarium | 1.10 mm. |
| | Diameter of peristome | 0.12 mm. |

*Variations.*—We have figured some zoarial variations, one of which has a very remarkable triangular palm tree shape. The zoarium is quite often free and the basal lamella is smooth. The peristomie disappears sometimes; in which case the zoarium offers the aspect of *Cellulipora.*

*Occurrence.*—Midwayan (Clayton limestone): One mile west of Fort Gaines, Georgia (common); Luverne, Crenshaw County, Alabama (very rare).

*Cotypes.*—Cat. No. 65252, U.S.N.M.

### PROBOSCINA RUGOSA, new species.

Plate 116, figs. 8–9.

*Description.*—The zoarium is biserial and incrusts shells and bryozoa. The tubes are cylindrical, arranged alternately and covered with large transverse and very salient wrinkles. The peristome is orbicular, thick, little salient. The branches commence with a single zooecium and terminate in two, three, or four nonalternated ones. There are some secondary branches which commence with two zooecia.

| | | |
|---|---|---|
| *Measurements.*— | Maximum width of zoarium | 0.40 mm. |
| | Length of tubes | 0.80–0.90 mm. |
| | Diameter of peristome | 0.20 mm. |

*Occurrence.*—Middle Jacksonian: Eutaw Springs, South Carolina (rare).

*Holotype.*—Cat. No. 65272, U.S.N.M.

### PROBOSCINA PROJECTA, new species.

Plates 116, figs. 6–7.

*Description.*—The zoarium is biserial and incrusts bryozoa, emitting branches at the principal points of curvature. The tubes are indistinct, arranged alternately, striated transversally. The peristome is thin, orbicular, oblique. The peristomie is very *salient* and oblique. The branches commence always with an isolated tube.

| | | |
|---|---|---|
| *Measurements.*— | Maximum width of zoarium | 0.60 mm. |
| | Length of tube | 1.40 mm. |
| | Diameter of peristome | 0.24–0.30 mm. |
| | Length of peristomie | 0.30 mm. |

*Affinities.*—This species differs from *Prosboscina geminata* in its larger peristome (more than 0.20 mm.) and in its larger peristomie.

*Occurrence.*—Middle Jacksonian (Castle Hayne limestone): Wilmington, North Carolina (rare).

Upper Jacksonian (Ocala limestone): West bank Sepulga River, Escambia County, Alabama (very rare).

*Holotype.*—Cat. No. 65271, U.S.N.M.

### PROBOSCINA GEMINATA, new species.

Plate 120, figs. 1–3.

*Description.*—The zoarium is *biserial*, and incrusts cyclostomatous bryozoa. The tubes are cylindrical, rarely distinct, arranged alternately, striated transversally. The peristome is round, horizontal, little oblique, very thick; the peristomie is very long, scarcely oblique. In the short branches, the tubes are not alternated; the peristomes are at the same height and appear geminate, but this phenomenon is rather rare.

| | | |
|---|---|---|
| *Measurements.*— | Maximum width of zoarium | 0.48 mm. |
| | Diameter of tube | 0.24 mm. |
| | Length of tube | 1.00–1.40 mm. |
| | Diameter of peristome | 0.20 mm. |
| | Length of peristomie | 0.24–0.30 mm. |

*Affinities.*—This large species is quite close to *Proboscina projecta*, but differs from it in its peristome of smaller diameter (0.20 mm. instead of 0.24 mm.) and its peristomie a little shorter and much more erect.

*Occurrence.*—Lower Jacksonian (Moodys marl): Jackson, Mississippi (rare).

Middle Jacksonian (Castle Hayne, limestone): Wilmington, North Carolina (rare).

*Cotypes.*—Cat. No. 65278, U.S.N.M.

### PROBOSCINA ANCEPS, new species.

Plate 120, figs. 4, 6.

*Description.*—The zoarium is biserial and incrusts shells emitting sublinear branches. The tubes are indistinct, geminate, striated transversely. The peristome is orbicular, thick, little salient, irregularly fringed. The branches are often uniserial. This species is provided with the *largest* peristome of all the American species.

| | | |
|---|---|---|
| *Measurements.*— | Maximum width of zoarium | 0.40 mm. |
| | Length of tube | 1.40 mm. |
| | Diameter of peristome | 0.30–0.34 mm. |

*Occurrence.*—Middle Jacksonian (Castle Hayne limestone): Wilmington, North Carolina (rare).

*Cotypes.*—Cat. No. 65279, U.S.N.M.

### PROBOSCINA EXPATIATA, new species.

Plate 120, figs. 9, 10.

*Description.*—The zoarium is biserial and incrusts shells emitting wide branches which are not all dichotomous. The tubes are very wide, little convex, depressed, irregular, as if *expanded*, short. The peristome is thick, orbicular, or elliptical, very little salient.

| | | |
|---|---|---|
| *Measurements.*— | Maximum width of zoarium | 0.60–0.80 mm. |
| | Length of tube | 0.60 mm. |
| | Diameter of peristome | 0.20 mm. |

This very curious species with a flaccid aspect is easy to determine.

*Occurrence.*—Middle Jacksonian (Castle Hayne limestone): Wilmington, North Carolina (rare).

*Holotype.*—Cat. No. 65281, U.S.N.M.

### PROBOSCINA ALTERNATA, new species.

Plate 120, figs. 11, 12.

*Description.*—The zoarium is biserial and incrusts shells in narrow branches. The tubes are distinct, cylindrical, arranged alternately, striated transversely. The peristome is thin, obliquely orbicular; the peristomie is very salient, oblique, directed toward the exterior and *alternately* on each side of the median axis. The branches commence with an isolated zooecium.

| | | |
|---|---|---|
| *Measurements.*— | Maximum width of zoarium | 0.28 mm. |
| | Length of tube | 0.40–0.60 mm. |
| | Diameter of peristome | 0.12 mm. |
| | Diameter of peristomie | 0.24 mm. |

*Occurrence.*—Middle Jacksonian (Castle Hayne limestone): Wilmington. North Carolina (very rare).

*Holotype.*—Cat. No. 65282, U.S.N.M.

### PROBOSCINA DIVERGENS, new species.

Plate 120, fig. 13.

*Description.*—The zoarium is biserial and incrusts shells, and bryozoa in rectilinear branches. The tubes are cylindrical, alternated or opposite, finely striated transversally, short. The peristome is thin, elliptical; the peristomie is rather large and *diverges* from the median axis of the zoarium.

| | | |
|---|---|---|
| *Measurements.*— | Maximum width of zoarium | 0.35 mm. |
| | Length of tube | 0.30–0.40 mm. |
| | Diameter of peristome | 0.10 mm. |

*Affinities.*—This species differs from *Proboscina alternata* in its smaller tubes (less than 0.40 mm.) and in its peristomes opposite and not alternated.

*Occurrence.*—Middle Jacksonian: Near Lenuds Ferry, South Carolina (very rare).

Upper Jacksonian (Ocala limestone): Chipola River, east of Marianna, Jackson County, Florida (very rare).

*Holotype.*—Cat. No. 65283, U.S.N.M.

### PROBOSCINA COLUBRA, new species.

Plate 120, figs. 7, 8.

*Description.*—The zoarium is triserial and incrusts shells and branched, linear or massive bryozoa. The tubes are little distinct, cylindrical, arranged in transverse irregular rows and with adjacent peristomes. The peristome is thin, orbicular, little salient. The zoaria with branches widened like the head of a *snake* are rather rare; generally they are linear. The peristomes of a transverse series are never all adjacent; there is always one isolated· At the base of the branch, the peristomes are arranged in quincunx.

*Measurements.*—
Maximum width of zoarium 0.80 mm.
Length of tube 0.80–1.00 mm.
Diameter of peristome 0.20 mm.

*Occurrence.*—Middle Jacksonian, Wilmington, North Carolina (very rare); Eutaw Springs (rare), and near Lenuds Ferry, South Carolina (rare).

*Holotype.*—Cat. No. 65280, U.S·N·M.

### PROBOSCINA CLAVATULA, new species.

Plate 119, figs. 1, 2.

*Description.*—The zoarium is multiserial, symmetrical on each side of the ancestrula, incrusting shells; the branches are widened at their extremity in the form of a *peg* and commence with an isolated zooecium. The tubes are distinct, cylindrical, rather long. The peristome is round, oblique, salient, thin.

*Measurements.*—
Maximum width of zoarium 0.68 mm.
Length of tube 0.55 mm.
Diameter of peristome 0.12 mm.

*Occurrence.*—Middle Jacksonian: Wilmington, North Carolina (rare); 18 miles west of Wrightsville, Johnson County, Georgia (very rare); 3½ miles south of Perry, Georgia (very rare); Eutaw Springs (very rare); and near Lenuds Ferry, South Carolina (very rare).

Upper Jacksonian: (Ocala limestone). Alachua, Florida (very rare); west bank Sepulga River, Escambia County, Alabama (rare).

*Holotype.*—Cat. No. 65284, U.S.N.M.

### PROBOSCINA STRIATULA, new species.

Plate 119, figs. 5–8.

*Description.*—The zoarium is triserial and incrusts shells and cheilostomatous bryozoa in short branches enlarging at each bifurcation. The tubes are distinct, arranged in quincunx, regular, finely *striated* transversally. The peristome is thin, round or elliptical, little salient.

*Measurements.*—
Maximum width of zoarium 0.60 mm.
Length of tube 0.70–0.80 mm.
Diameter of peristome 0.16 mm.

*Occurrence.*—Middle Jacksonian: Eutaw Springs, South Carolina (rare); Wilmington, North Carolina (very rare).

*Cotypes.*—Cat. Nos. 65286, 65287, U.S.N.M.

### PROBOSCINA PROMINENS, new species.

Plate 119, figs. 9–11.

*Description.*—The zoarium is triserial and incrusts bryozoa in long and undulated branches. The tubes are distinct, cylindrical, punctate, arranged in quincunx. The peristome is thin, orbicular, oblique; the peristomie is very *salient* oblique, and often elevated to the vertical.

*Measurements.*—

| | |
|---|---|
| Maximum width of zoarium | 1.00 mm. |
| Length of tube | 0.60–0.80 mm. |
| Diameter of peristome | 0.14 mm. |
| Length of peristomie | 0.20 mm. |

*Affinities.*—This species differs from *Proboscina undulata* in its triserial zoarium (and not quadriserial) and in its much longer tubes (0.60 mm. and not 0.40 mm).

*Occurrence.*—Middle Jacksonian (Castle Hayne limestone): Wilmington, North Carolina (common).

*Cotypes.*—Cat. No. 65288, U.S.N.M.

### PROBOSCINA UNDULATA, new species.

Plate 119, figs. 3, 4.

*Description.*—The zoarium is quadriserial and incrusts shells in *undulated* branches. The tubes are little distinct, arranged in quincunx, slightly striated transversally. The peristome is thin, orbicular, oblique; the peristomie is rather large and oblique.

*Measurements.*—

| | |
|---|---|
| Length of tube | 0.40 mm. |
| Diameter of peristome | 0.12–0.16 mm. |
| Length of peristomie | 0.24 mm. |

*Occurrence.*—Middle Jacksonian (Castle Hayne limestone): Wilmington, North Carolina (very rare).

*Holotype.*—Cat. No. 65285, U.S.N.M.

### PROBOSCINA PARVIANGULATA, new species.

Plate 118, figs. 1–6.

*Description.*—The zoarium is bi- or tri-serial and incrusts bryozoa, orbitoid foraminifera, and shells in curved branches, diverging at the dichotomization at a very *small angle*. The tubes are distinct, cylindrical, a little wrinkled transversally. The peristome is thin, oblique, orbicular, or elliptical; the peristomie is oblique, sometimes elevated until it is vertical, curved, and rather long.

| | | |
|---|---|---|
| *Measurements.*— | Diameter of tube | 0.26 mm. |
| | Maximum width of zoarium | 0.60 mm. |
| | Length of tube | 0.60–0.90 mm. |
| | Diameter of peristome | 0.16–0.24 mm. |
| | Length of peristomie | 0.30–0.40 mm. |

*Variations.*—This species is very peculiar and easy to determine by its small angle of divergence. The branches begin always with an isolated zooecium and each recommences a series analogous to that which issues from the ancestrula itself. We have thus successively: Zooecia 1, 2, 2, separated, bifurcation; 1, 2, 3, bifurcation; 1, 2, 3, 4 (in transverse rows), bifurcation. The variations of this species are considerable, but invariably the angle of dichotomization remains very small.

*Occurrence.*—Middle Jacksonian: Near Lenuds Ferry, South Carolina (common); Eutaw Springs, South Carolina (rare); Wilmington, North Carolina (common).

*Cotypes.*—Cat. No. 65289, U.S.N.M.

### PROBOSCINA SUBECHINATA, new species.

Plate 152, figs. 1–2.

*Description.*—The zoarium incrusts shells in claviform and triserial branches. The tubes are distinct, cylindrical, arched, wrinkled transversally, in quincunx or in transverse series. The peristome is thin, orbicular, oblique; the peristomie is rather long and elevated to 45°.

| | | |
|---|---|---|
| *Measurements.*— | Maximum width of zoarium | 1.6 mm. |
| | Length of tube | 0.70–0.80 mm. |
| | Diameter of peristome | 0.18 mm. |

*Affinities.*—The angle of divergence appears to be small. The zooecia arranged in transverse series are frequent; the peristomies are always free and isolated.

In zoarial aspect this species much resembles *Proboscina echinata* Reuss, 1865. Unfortunately we are ignorant of the micrometric measurements of this species and no specimen is known in the European museums. Canu in 1909 believed it ought to be compared with *Proboscina major* Johnston, 1847, but this was only a suggestion. The specimens of *Proboscina major* Johnston, 1847, collected in the Mediterranean, have a peristome somewhat wider than that of our American specimens of the present species.

*Occurrence.*—Vicksburgian (Marianna limestone): Near Claiborne, Monroe County, Alabama (rare); Salt Mountain 5 miles south of Jackson, Alabama (rare).

*Holotype.*—Cat. No. 65375, U.S.N.M.

### PROBOSCINA EXIGUA, new species.

Plate 118, figs. 7–9.

*Description.*—The zoarium is multiserial and incrusts shells in branches enlarged distally. The tubes are *small*, distinct, cylindrical, arranged in quincunx or in transverse series. The peristome is thin, orbicular, salient. The branches are sometimes regularly rectilinear; they never commence with an isolated zooecium. The distance apart of the zooecia in quincunx is from 0.40 to 0.50 mm.

| | | |
|---|---|---|
| *Measurements.*— | Maximum width of zoarium | 1.6 mm. |
| | Length of tube | 0.40–0.50 mm. |
| | Diameter of peristome | 0.10–0.12 mm. |

*Affinities.*—In the arrangement of its tubes and in the aspect of the zoarium, this species much resembles *Proboscina colubra;* it differs from it in its much smaller micrometric measurements.

*Occurrence.*—Upper Jacksonian (Ocala limestone): Chipola River east of Marianna, Jackson County, Florida (rare).

*Cotypes.*—Cat. No. 65290, U.S.N.M.

### PROBOSCINA RECTALINEA, new species.

Plate 152, figs. 3–7.

*Description.*—The zoarium is multiserial and incrusts shells in *linear* branches. The tubes are little distinct, cylindrical, arranged in quincunx, feebly striated transversally. The peristome is thin, salient, orbicular, somewhat oblique.

| | | |
|---|---|---|
| *Measurements.*— | Maximum width of zoarium | 0.80 mm. |
| | Length of tube | 0.35–0.48 mm. |
| | Diameter of peristome | 0.12 mm. |

*Variations.*—The first branches are triserial; they never start with an isolated zooecium. The branches are directed in a *straight line* with remarkable regularity. The protoecium is orbicular and very small; its diameter is 0.12 mm.

*Affinities.*—The tubes are of the size of those of *Proboscina exigua*, but the present species differs from it in its much more salient peristome, and in its zooecia arranged in more crowded quincunx.

*Occurrence.*—Vicksburgian (Marianna limestone): Salt Mountain, 5 miles south of Jackson, Alabama (rare).

*Cotypes.*—Cat. No. 65376, U.S.N.M.

### PROBOSCINA CONVENIENS, new species.

Plate 152, figs. 10–12.

*Description.*—The zoarium is multiserial and incrusts shells; the branches are arranged *symmetrically* on each side of the ancestrula; they have the form of an elongate palm leaf. The tubes are indistinct, arranged in regular quincunx. The peristome is thick, salient, orbicular.

| | | |
|---|---|---|
| *Measurements.*— | Maximum width of zoarium | 1.00 mm. |
| | Length of tube | 0.30 mm. |
| | Diameter of peristome | 0.12 mm. |

*Affinities.*—This species much resembles *Diaperoecia clava*, new species, but differs in its much thicker peristome and in its micrometric measurements. We believe that the discovery of the ovicell of this species would classify it in *Diaperoecia.*

*Occurrence.*—Vicksburgian (Marianna limestone): Salt Mountain, 5 miles south of Jackson, Alabama (rare).

*Cotypes.*—Cat. No. 65378, U.S.N.M.

### PROBOSCINA CLAVATIRAMOSA, new species.

Plate 153, figs. 1, 2.

*Description.*—The zoarium incrusts shells in multiserial *claviform branches.* The tubes are scarcely distinct, cylindrical, arranged in quincunx 0.36 mm. apart. The peristome is thin, salient, orbicular.

*Measurements.*—

| | |
|---|---|
| Maximum width of zoarium | 1.00 mm. |
| Length of tube | 0.40 mm. |
| Diameter of peristome | 0.10 mm. |

*Affinities.*—This species differs from *Proboscina conveniens* in its claviform branches, much narrowed at their base, and in the much more scattered arrangement of the peristomes.

*Occurrence.*—Vicksburgian (Marianna limestone): Salt Mountain, 5 miles south of Jackson, Alabama (rare); near Claiborne, Monroe County, Alabama (rare).

*Holotype.*—Cat. No. 65379, U.S.N.M.

### PROBOSCINA LATOBREVIS, new species.

Plate 118, figs. 10-12.

*Description.*—The zoarium is biserial and incrusts shells and orbitoid foraminifera in short and undulated branches. The tubes are distinct, *wide* and *short*, punctate, arranged alternately. The peristome is thin, salient orbicular, oblique. The branches commence with a very large zooecium.

*Measurements.*—

| | |
|---|---|
| Maximum width of zoarium | 0.70–0.80 mm. |
| Length of tube | 0.60–0.80 mm. |
| Diameter of peristome | 0.22–0.30 mm. |

*Variations.*—The tubes in the vicinity of the ancestrula have no constant micrometric measurements; the peristome increases gradually from 0.14 to 0.22 mm.; the length of the tubes grows from 0.50 to 0.70 mm. Sometimes the branches are triserial; when two zooecia are adjacent their peristomes remain free.

The phenomenon of rejuvenation is rather rare. Here the branches commence indeed in a single zooecium, but it is enormous when the ancestrula is very small.

*Occurrence.*—Upper Jacksonian (Ocala limestone): Old Factory about 1½ miles above Bainbridge, Georgia (rare).

Vicksburgian (Marianna limestone): Near Claiborne, Monroe County, Alabama (rare).

*Cotypes.*—Cat. Nos. 65291, 65292, U.S.N.M.

### PROBOSCINA CRANEI, new species

Plate 152, figs. 8, 9.

*Description.*—The zoarium incrusts shells in large, short, triserial claviform branches. The tubes are indistinct, large, short, arranged in quincunx or in transverse rows. The peristome is very thick, orbicular, somewhat oblique. The zooecia are generally adjacent, two by two, but they are sometimes isolated.

We dedicate this vigorous species to our friend, Mr. W. E. Crane, who has collected many bryozoa for us both in Europe and America.

| | | |
|---|---|---|
| *Measurements.*— | Maximum width of zoarium | 1.00 mm. |
| | Length of tube | 0.40 mm. |
| | Diameter of peristome | 0.28 mm. |

*Occurrence.*—Vicksburgian (Marianna limestone): Salt Mountain, 5 miles south of Jackson, Alabama (very rare).

*Holotype.*—Cat. No. 65377, U.S.N.M.

### PROBOSCINA IDMONEOIDES, new species.

Plate 117, figs. 1–4.

*Description.*—The zoarium incrusts shells in rectilinear, multiserial branches. The tubes are distinct, cylindrical, arranged in divergent rows on each side of the zoarial axis. The peristome is thin, salient, elliptical, with a distal extremity often pointed; the peristomie is short, bent upward, oblique, directed toward the lateral margins of the zoarium. All the branches are not clearly idmoneiform, but the zooecia are always arranged in oblique rows. Evidently the peristomes are always free and wide spread.

| | | |
|---|---|---|
| *Measurements.*— | Maximum width of zoarium | 1.5 mm. |
| | Length of tube | 0.30–0.40 mm. |
| | Diameter of peristome | 0.14 mm. |

*Occurrence.*—Upper Jacksonian (Ocala limestone): Old Factory about 1½ miles above Bainbridge, Georgia (rare); Red Bluff on Flint River, 7 miles above Bainbridge, Georgia (rare).

*Cotypes.*—Cat. No. 65293, U.S.N.M.

### PROBOSCINA MAGNIRAMOSA, new species.

Plate 117, figs. 6, 7.

*Description.*—The zoarium is multiserial and incrusts Cellepores in undulated *large branches.* The tubes are little distinct, cylindrical, arranged in quincunx, rather regular and crowded. The peristome is orbicular, very oblique, thin; the peristomie is long and oblique.

| | | |
|---|---|---|
| *Measurements.*— | Maximum width of zoarium | 2.00 mm. |
| | Length of tube | 0.30–0.40 mm. |
| | Diameter of peristome | 0.16 mm. |
| | Length of peristomie | 0.32 mm. |

*Variations.*—Our zoarium is unfortunately incomplete. We can note, however, the great irregularity in the arrangement of the tubes; they are more scattered on one branch than on another; the length of their peristomie is quite variable; the separation of the peristomes varies from one to two times. It is impossible to clearly characterize this species.

*Occurrence.*—Jacksonian (Zeuglodon zone): Bluff on south side of Suck Creek, Clarke County, Mississippi (very rare).

*Holotype.*—Cat. No. 65295, U.S.N.M.

### Forma BERENICEA Lamouroux, 1821.

1821. *Berenicea* Lamouroux, Exposition Methodique des polypiers, p. 80.

The zoarium is a thin, unilamellar, incrusting sheet. It is generally orbicular, suborbicular, or flabelliform.

*Genotype.*—*Berenicea prominens* Lamouroux, 1821.

*Range.*—Ordovician-Recent.

Like *Proboscina* the ancient name *Berenicea* is retained in a zoarial sense to include those species of lamellar incrusting Cyclostomata, showing no ovicell. As noted on subsequent pages, species of *Berenicea* preserving ovicell are referred to several distinct genera and indeed families. A large number of species have the ovicell of *Plagioecia*, but others belong to *Oncousoecia*, *Mecynoecia*, *Microecia*, *Diaperoecia*, and *Diplosolen*.

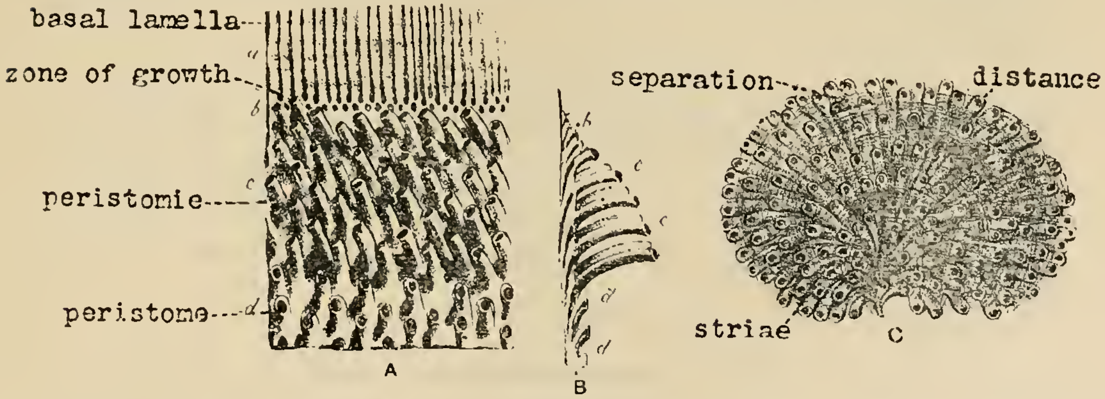


Fig. 216.—Forma *Berenicea* Lamouroux, 1821.

A–C. Two species of *Berenicea* showing the terminology employed in this and similar Cyclostomata.

#### BERENICEA PALMULA, new species.

Plate 105, figs. 5, 6.

*Description.*—The zoarium incrusts shells and is formed of *flabelliform*, bifurcated, short, pluriserial branches. The zone of growth is much reduced. The tubes are little distinct, oval, smooth, arranged in quincunx. The peristomie is short, oblique, or raised vertically. The peristome is thick, orbicular, somewhat oblique. The ancestrula is very small, with an orbicular protoecium.

| | | |
|---|---|---|
| *Measurements.*— | Diameter of the peristomes | 0.12 mm. |
| | Distance between the peristomes | 0.50 mm. |
| | Separation of the peristomes | 0.44 mm. |
| | Diameter of the zooecia | 0.24–0.30 mm. |

The length of the tubes is extremely variable; it is even very difficult to find a place where the tubes are arranged in quincunx, permitting the exact measurement of their separation.

*Occurrence.*—Midwayan (Clayton limestone): One mile west of Fort Gaines, Georgia (very rare).

*Holotype.*—Cat. No. 65251, U.S.N.M.

### BERENICEA UNDATA, new species.

Plate 105, fig. 12.

*Description.*—The zoarium is orbicular and incrusts shells; the zone of growth is thick, but very narrow. The tubes are cylindrical, little distinct, little erect at the extremity; ornamented with small, overlapping *wrinkles.* The peristome is salient, thin, elliptical, elongate.

| | | |
|---|---|---|
| *Measurements.*— | Diameter of the peristome | 0.08–0.10 mm. |
| | Distance between the peristomes | 0.50 mm. |
| | Separation of the peristomes | 0.32–0.36 mm. |

*Affinities.*—This species differs from *Diaperoecia rugosa*, new species, in its much smaller and less salient overlapping undulations.

*Occurrence.*—Midwayan (Clayton limestone): Luverne, Crenshaw County, Alabama (very rare).

*Holotype.*—Cat. No. 65253, U.S.N.M.

### BERENICEA STIPATA, new species.

Plate 106, figs. 1–2.

*Description.*—The zoarium is irregularly orbicular; the zone of growth is very narrow and thick. The tubes are cylindrical, indistinct, erect at the extremity, much *crowded* against each other. The peristome is thin, orbicular, very oblique.

| | | |
|---|---|---|
| *Measurements.*— | Diameter of the peristome | 0.14 mm. |
| | Distance between the peristomes | 0.08 mm. |
| | Separation of the peristomes | 0.12 mm. |

*Occurrence.*—Midwayan (Clayton limestone): Luverne, Crenshaw County, Alabama (very rare).

*Holotype.*—Cat. No. 65419, U.S.N.M.

### BERENICEA BREVISSIMA, new species.

Plate 106, fig. 3.

*Description.*—The zoarium is orbicular and incrusts shells; the zone of growth is very narrow. The tubes are indistinct, very erect, *quite short*, pressed against each other. The peristome is thin, orbicular, oblique.

| | | |
|---|---|---|
| *Measurements.*— | Diameter of the peristome | 0.10 mm. |
| | Distance between the peristomes | 0.32 mm. |
| | Separation of the peristomes | 0.35 mm. |

*Occurrence*—Midwayan (Clayton limestone): One mile west of Fort Gaines, Georgia (very rare).

*Holotype.*—Cat. No. 65420, U.S.N.M.

### BERENICEA INGENS, new species.

Plate 117, fig. 5.

*Description.*—The zoarium is flabelliform and incrusts bryozoa. The tubes are *very large*, punctate and horn-shaped. The peristome is thin, orbicular or elliptical, salient.

| | | |
|---|---|---|
| *Measurements.*— | Diameter of the peristome | 0.18 mm. |
| | Distance between the peristomes | 0.80 mm. |
| | Separation of the peristomes | 0.42 mm. |

*Occurrence.*—Lower Jacksonian: Three and one-half miles southeast of Shell Bluff post office, Georgia (very rare).

*Holotype.*—Cat. No. 65294, U.S.N.M.

### BERENICEA BENJAMINI, new species.

Plate 117, figs. 8, 9.

*Description.*—The zoarium incrusts shells; it is orbicular or irregular; the zone of growth is very small. The tubes are distinct, cylindrical, scattered, striated transversally. The peristome is thin, salient, orbicular; the peristomie is much bent upward and erect.

| | | |
|---|---|---|
| *Measurements.*— | Diameter of the peristome | 0.20 mm. |
| | Distance between the peristomes | 0.60–0.70 mm. |
| | Separation of the peristomes | 0.80 mm. |

The specific name is in honor of Dr. Marcus Benjamin, of the United States National Museum, who has taken an interest in our work since its inception, and to whom we are indebted for many courtesies.

*Occurrence.*—Middle Jacksonian: Eutaw Springs, South Carolina (rare).

*Holotype.*—Cat. No. 65296, U.S.N.M.

### BERENICEA INCONDITA, new species.

Plate 121, figs. 10, 11.

*Description.*—The zoarium incrusts bryozoa; it is developed in wide dichotomous, irregular lobes. The tubes are distinct, cylindrical, arranged in quincunx, smooth. The peristome is thick, orbicular, or elliptical, little salient.

| | | |
|---|---|---|
| *Measurements.*— | Diameter of peristome | 0.16 mm. |
| | Zooecial diameter | 0.20 mm. |
| | Diameter of the orifice | 0.08–0.10 mm. |
| | Distance between the peristomes | 0.20–0.50 mm. |
| | Separation of the peristomes | 0.20–0.40 mm. |

This species is possibly a *Proboscina.*

*Occurrence.*—Middle Jacksonian: Rich Hill, 5½ miles southeast of Knoxville, Crawford County, Georgia (rare).

*Holotype.*—Cat. No. 65301, U.S.N.M.

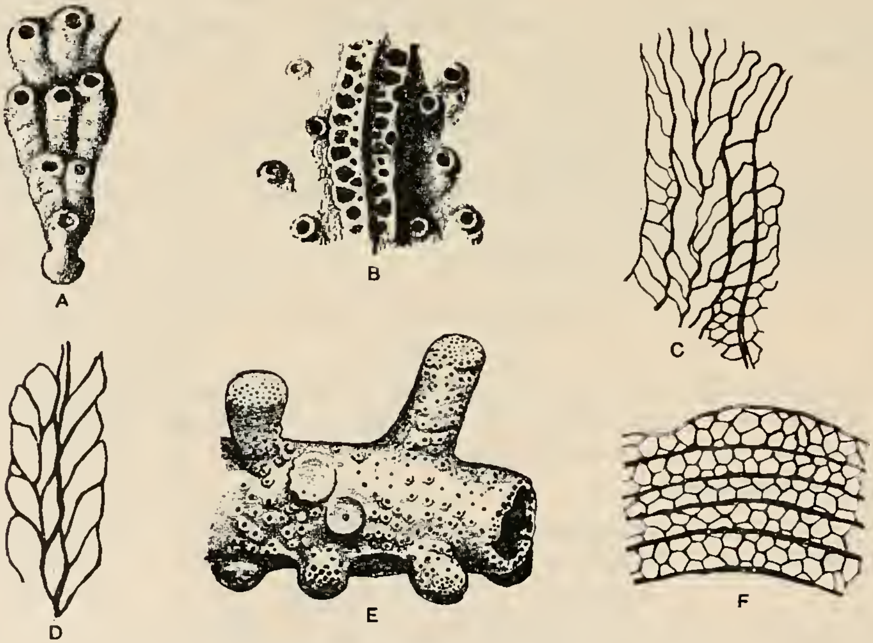


FIG. 217.—Forma *Diastopora* Lamouroux, 1821.

A. The initial stomatoporoid cell of *Diastopora davidsoni* Haime, 1854, showing expansion to berenicoid condition. B. Base of *Diastopora davidsoni* Haime, 1854, showing basal berenicoid encrustation and erect frond. C. Section through frond of *Diastopora lamellosa cervicornis* Michelin, 1846, to show multiple growth. D. Longitudinal section through a frond of *Diastopora* showing zoarial lamina. E. A *Diastopora* giving off shoots in the condition of *Entalophora*. F. Transverse section across part of a zoarium of *Reptomultisparsa* showing concentric layers. (Figs. A–F after Gregory, 1896.)

### Forma DIASTOPORA Lamouroux, 1821.

1821. *Diastopora* Lamouroux, Exposition Méthodique des Polypiers, p. 42.

The zoarium is unilaminar.

*Historical.*—Gregory, 1899 (p. 127), included in the genus *Diastopora* all the free forms, uni- or bi-laminar, branched or bushy. Even thus understood, this is not a natural genus, because the ovicell is of a quite varied form and nature. Under these conditions we believe it necessary to recognize the zoarial forms in the exact sense of their authors. The discovery of their ovicells will later permit the classification of the species. According to D'Orbigny, *Diastopora* is unilamellar, *Bidiastopora* is bilamellar and branched, and *Mesenteripora* is lobate, bushy, and meandriform.

#### DIASTOPORA TUBAEDES, new species.

Plate 106, figs. 4, 5.

*Description.*—The zoarium incrusts small branched algae; it is cylindrical, *tubular*, branched; the zone of growth is very small. The tubes are cylindrical, arranged in regular quincunx, straight, and never bent upward. The peristome is thin, orbicular, oblique; the peristomie is salient, rectilinear.

| | | |
|---|---|---|
| *Measurements.*— | Diameter of the peristome | 0.14 mm. |
| | Distance between the peristomes | 0.40–0.50 mm. |
| | Separation of the peristomes | 0.52 mm. |
| | Length of the peristomie | 0.16 mm. |

*Occurrence.*—Midwayan (Clayton limestone): Luverne, Crenshaw County, Alabama (very rare).

*Holotype.*—Cat. No. 65421, U.S.N.M.

#### DIASTOPORA TUBIFORMIS, new species.

Plate 121, fig. 8.

*Description.*—The zoarium incrusts the delicate branched radicells of algae; it is *hollow*, cylindrical, branched; the zone of growth is rather wide. The tubes are distinct, cylindrical, somewhat bent upward, striated transversally. The peristome is elliptical, thin, a little salient, often closed by an entire smooth lamella. There is no peristomie.

| | | |
|---|---|---|
| *Measurements.*— | Diameter of the peristomes | 0.12 (0.12–0.16) mm. |
| | Distance between the peristomes | 0.44–0.60 mm. |
| | Separation of the peristomes | 0.50 mm. |

*Occurrence.*—Middle Jacksonian: Near Lenuds Ferry, South Carolina (rare).

*Holotype.*—Cat. No. 65299, U.S.N.M.

### DIASTOPORA STRIATISEMOTA, new species.

Plate 121, fig. 9.

*Description.*—The zoarium is formed of wide, expanded fronds. The tubes are indistinct at their base, cylindrical at their extremity, arranged in widespread quincunx, garnished with small thin and *scattered striations.* The peristome is thin, orbicular, oblique, or elliptical when it is horizontal; the peristomie is salient. oblique, erect. The basal lamella is smooth.

| | | |
|---|---|---|
| *Measurements.*— | Diameter of the peristome | 0.10 mm. |
| | Distance between the peristomes | 0.40–0.50 mm. |
| | Separation of the peristomes | 0.40 mm. |
| | Length of the peristomie | 0.12 mm. |

*Affinities.*—This species differs from *Diaperoecia rugosa*, new species, by the transverse, little salient wrinkles and a lesser zooecial length.

*Occurrence.*—Upper Jacksonian (Ocala limestone): Chipola River, east of Marianna, Jackson County, Florida (very rare).

Middle Jacksonian: Seventeen miles northeast of Hawkinsville, Georgia (rare).

*Holotype.*—Cat. No. 65300, U.S.N.M.

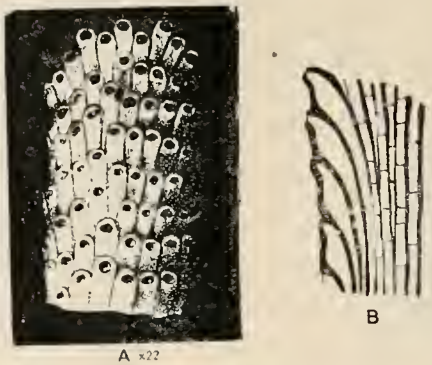


Fig. 218.—Forma *Spiropora* Lamouroux, 1821.

A. Zoarium, of *Spiropora tetragona* Lamouroux, 1821. B. Longitudinal section, through half of zoarium of *Spiropora richmondensis* Vine, 1884. (After Gregory, 1896.)

### DIASTOPORA MAGNIPORA, new species.

Plate 153, figs. 3, 4.

*Description.*—The zoarium is formed of a unilamellar and flabellate frond. The tubes are *enormous*, wide, oval, distinct at their base, somewhat upward bent. The peristome is very thick, orbicular, or elliptical, very salient; the peristomie is short, raised to 45°.

| | | |
|---|---|---|
| *Measurements.*— | Diameter of the peristomes | 0.20–0.24 mm. |
| | Diameter of the apertura | 0.10–0.12 mm. |
| | Distance between the peristomes | 0.70–0.80 mm. |
| | Separation of the peristomes | 0.64 mm. |
| | Length of the peristomie | 0.32 mm. |

*Occurrence.*—Vicksburgian (Marianna limestone): Salt Mountain, 5 miles south of Jackson, Alabama (very rare).

*Holotype.*—Cat. No. 65380, U.S.N.M.

### Forma SPIROPORA Lamouroux, 1821.

1821. *Spiropora* Lamouroux, Exposition Methodique des Polypiers, p. 47.

The apertures of the zooecia open in regular annular or spiral lines. The zooecia are regularly cylindrical.

*Genotype.—Spiropora elegans* Lamouroux, 1821.

The ovicell of *Spiropora* has never been found, in spite of the large number of specimens collected. It is probable that it does not exist and that the larva is developed in a small distal sack of an ordinary tube. An important character is the presence of diaphragms in the tubes at different heights.

### SPIROPORA MAJUSCULA, new species.

Plate 128, figs. 8–13.

*Description.*—The zoarium is formed of *very large*, cylindrical and dichotomous branches. The tubes are distinct, flat, separated by a salient thread. The fascicles form annular, salient, regular verticells, broken and incomplete at the bifurcations.

| | | |
|---|---|---|
| *Measurements.*— | Diameter of the peristome | 0.33 mm. |
| | Diameter of the tubes | 0.25 mm. |
| | Distance between the verticells | 1.08 mm. |
| | Diameter of the branches | 1.50–2.00 mm. |

*Affinities.*—This is the largest species of *Spiropora* known. Its regularity is rather remarkable. In longitudinal section the diaphragms appear not only at the base of the tubes, but at different heights; they are scattered or close together. In transversal section the zooecia are separated by a clear line, the calcification of the tubes being more intense in the interior.

*Occurrence.*—Middle Jacksonian: Near Lenuds Ferry, South Carolina (very common); Eutaw Springs, South Carolina (common).

*Cotypes.*—Cat. No. 65322, U.S.N.M.

### (b) TREPOSTOMATOUS LIKE CYCLOSTOMATA.

## Family HETEROPORIDAE Pergens and Meunier, 1886.

1886. Pergens and Meunier, La faune des Bryozoaires garumniens de Faxe, Annales de la Société Royale malacologique de Belgique, vol. 21, p. 223.

No ovicell. The tubes are cylindrical.

*Historical.*—We here reunite in the same family the species grouped formerly under the two well-known families—Heteroporidae and Cerioporidae. We now know that the presence of mesopores is not a family character. The family Cerioporidae not having been created until 1894 by Hennig, priority is secured by the family of Pergens and Meunier.

*Organization.*—All the known anatomical features have been summarized in figure 219; they are of little importance. They show us, however, that the parietal vesicles do not contain any special organ and do not constitute a character of classification of great value. We know (see General Consideration, on page 634) that the tubes are not exactly adjacent: they are separated (according to Calvet) by the

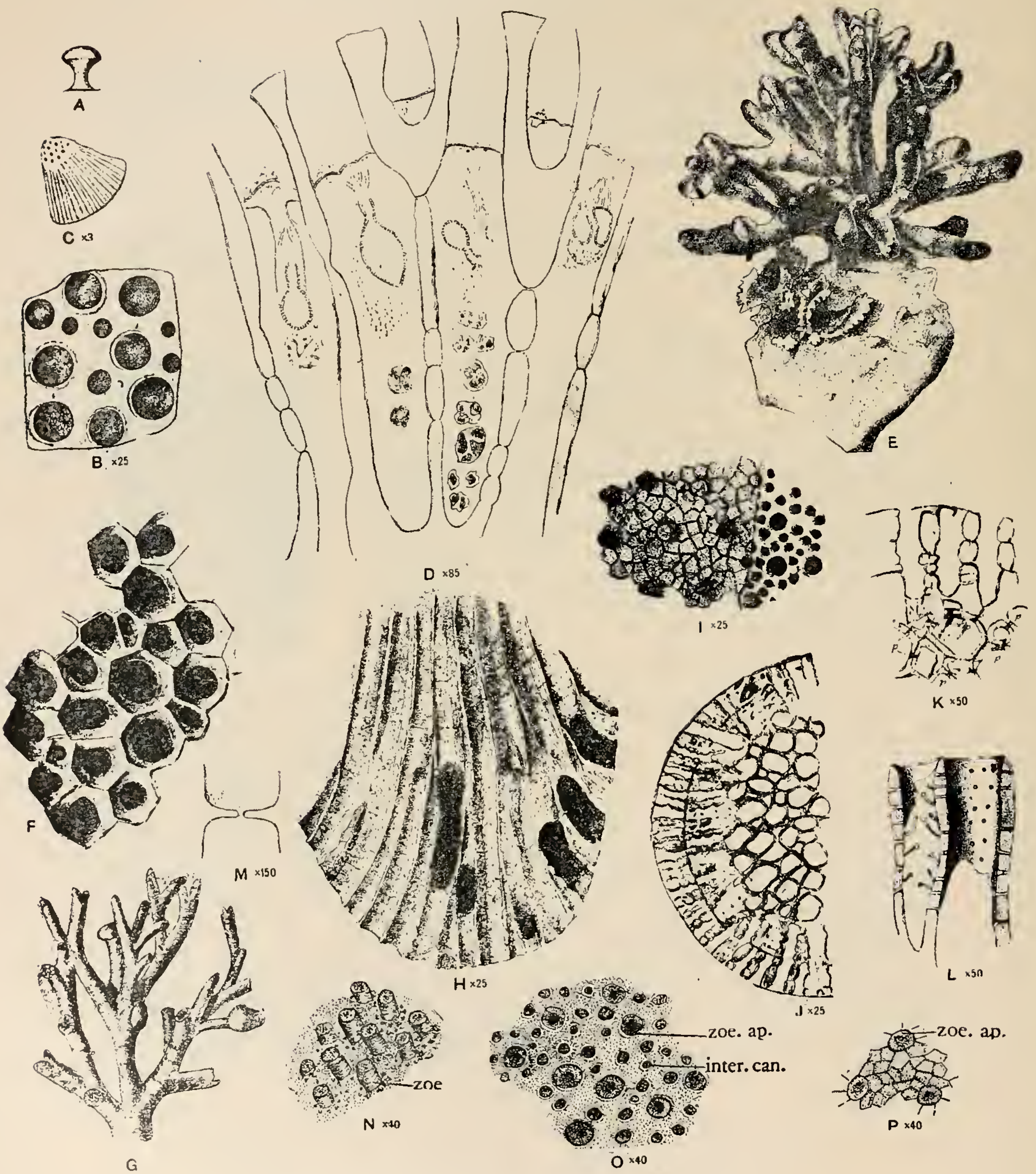

A
C ×3
B ×25
D ×85
E
I ×25
K ×50
F
M ×150
H ×25
J ×25
L ×50
G
N ×40
zoe
O ×40
zoe. ap.
inter. can.
P ×40
zoe. ap.

Fig. 219.—Family Heteroporidae Pergens and Meunier, 1886

FIG. 219.—Family Heteroporidae Pergens and Meunier, 1886.

A–D. *Heteropora claviformis* Waters, 1904. A. Zoarium, natural size. B. Portion of a surface, × 25. C. A broken colony, × 3, showing the transverse section. D. Longitudinal decalcified section, × 85, showing closures traversed by the mesenchyme and the vesicular wall. Histolysis had commenced. (After Waters, 1904.)

E–F. *Heteropora neozelanica* Busk, 1879. E. Zoarium, natural size. F. Portion of the surface, enlarged. (After Busk, 1879.)

G–P. *Heteropora pelliculata* Waters, 1879. G. Zoarium, natural size. H. Longitudinal section, × 25, drawn with the growing end downward. I. Surface, × 25, with portion to right showing thin covering removed. J. Transverse section, × 25. K. Portion of the transverse section, × 50. (G–K after Waters, 1879.) L. Section showing the interzooecial pores and the hair-like spines, × 50. M. Interzooecial pores, × 150. (L, M after Waters, 1884.) N. Portion of the surface of a colony, × 40, showing the projection of the zooecial tubes beyond the surface (*zoe*) when in a sheltered position. O. Portion of the surface of a branch × 40, showing the zooecial apertures (*zoe. ap.*) and the apertures of the interstitial canals (mesopores) (*inter. can.*). P. Portion of the surface of a colony, × 40, in which the interstitial canals are covered by a delicate calcareous layer. The zooecial apertures only are visible (*zoe. ap.*). (N–P after Robertson, 1910.)

membraneous ectocyst, the disappearance of which leaves a clear line as seen in thin sections. The vesicles are formed by contractions of this ectocyst in front of the communication pores. We know also, according to Calvet, that in the general cavity of each polypide a large group of leucocytes are placed in proximity to each of these pores.

*Classification.*—We have adopted the classification of Gregory, 1909, because at present it is impossible to do otherwise. It is evident that many of our species will have to be changed to other families, if, as we suppose, the discovery of their ovicell is possible.

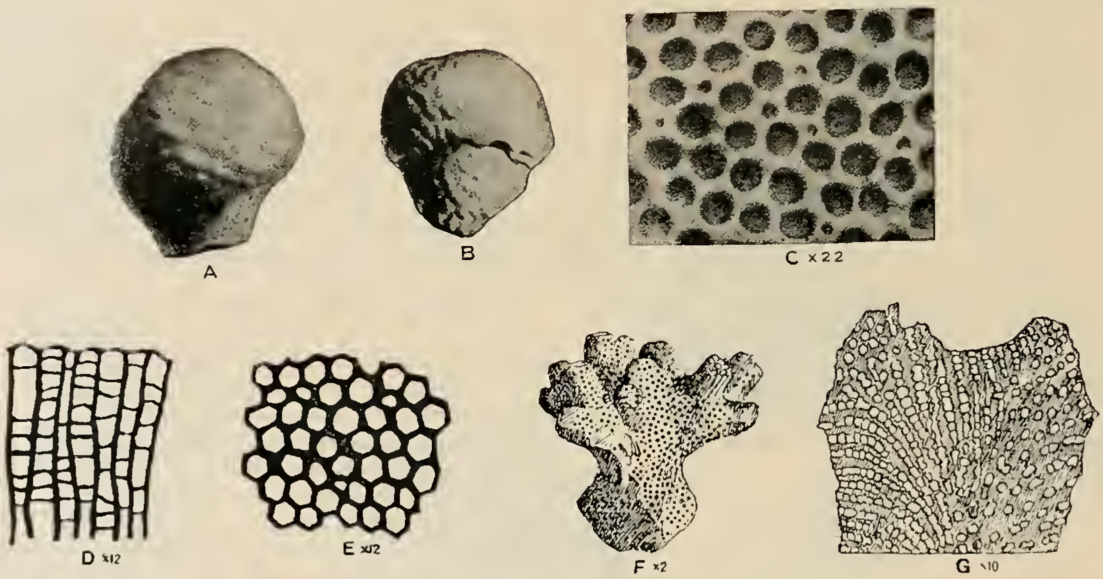


Fig. 220.—Forma *Ceriopora* Goldfuss, 1827.

A–E. *Ceriopora globosa* Michelin, 1846. A, B. Zoarium natural size. (After Michelin, 1846.) C. Portion of the surface, × 22. D. Longitudinal section through marginal zooecia, showing diaphragms, × 12. E. Transverse section through central zooecia, × 12. (C–E after Gregory, 1896.)

F ,G. *Ceriopora tuberosa* Römer, 1839. F. Zoarium, × 2. G. Vertical section, × 10, showing vesicular wall. (After Gregory, 1909.)

### Genus CERIOPORA Goldfuss, 1827.

1827. *Ceriopora* Goldfuss, Petrefacta Germaniae, Abbildungen und Beschreibungen der Petrefacten Deutschlands und der angrenzenden Länder, Düsseldorf, vol. 1, p. 33.

The tubes are prismatic or subcylindrical. No mesopores. The diaphragms are numerous and horizontal. The zoarium is massive or branched.

*Genotype.*—*Ceriopora micropora* Goldfuss, 1827.

*Range.*—Triassic-Miocene.

The tubes are branched at all heights. Externally they are not all of the same diameter; the smaller are not mesopores, but are rudimentary zooecia, which are developed superiorly. Many successive polypides occupy, in fact, the same tube.

*Ceriopora micropora* Goldfuss, 1827, has been identified by Ulrich in the Eocene of Maryland, but the single specimen found is not sufficient for a detailed study.

### CERIOPORA VESICULOSA, new species.

Plate 111, figs. 5–10.

The zoarium is massive and subelliptical. The orifices are polygonal and are 0.10 mm. in width at the maximum. The walls of the tubes are vesicular. Diaphragms are rare. There are many concentric lines of large *vesicles.*

*Affinities.*—The concentric lines of large vesicles give this species, in longitudinal sections, the aspect of *Reptomulticava.* However, there is no real separation between the successive layers apparent and there are no superposed subcolonies.

*Occurrence.*—Midwayan (Clayton limestone): Mabelvale, near Little Rock, Arkansas (rare); Luverne , Crenshaw County, Alabama (very rare); 1 mile west of Fort Gaines, Georgia (common).

*Holotype.*—Cat. No. 65255, U.S.N.M.

### CERIOPORA ALDRICHI, new species.

Plate 151, figs. 11–17.

*Description.*—The zoarium incrusts small cylindrical bodies, rootlets, small algae or branching bryozoa; it is hollow or solid. The walls of the cylindrical tubes are vesicular only at their extremity. The orifices are polygonal and measure 0.14–0.16 mm. in width.

This interesting and abundant species is named in honor of Mr. T. H. Aldrich, of Birmingham, Alabama, in recognition of his work upon the Tertiary paleontology of the United States.

*Occurrence.*—Middle Jacksonian (Castle Hayne limestone): Wilmington North Carolina (common).

*Cotypes.*—Cat. No. 65370, U.S.N.M.

### CERIOPORA (?) PROPOSITA, new species.

Plate 151, figs. 7–10.

*Description.*—The zoarium is *spread out* in irregular masses, much compressed, nonglobular, with the lower face covered by a striated epitheca. The orifices are polygonal and measure 0.12 mm. at the maximum. The walls of the tubes are irregularly vesicular. There are many concentric lines of large vesicles.

*Affinities.*—The species, in longitudinal sections, somewhat resembles *Ceriopora vesiculosa* in its concentric lines of large vesicles, but differs from it in its expanded, nonmassive, and nonglobular zoarium.

*Occurrence.*—Middle Jacksonian: Three and one-fourth miles south of Perry, Georgia (common).

*Holotype.*—Cat. No. 65369, U.S.N.M.

### Genus REPTOMULTICAVA D'Orbigny, 1852.

1852. *Reptomulticava* D'ORBIGNY, Paléontologie française, descriptions des animaux invertébres, Terrain Crétacé, vol. 5, p. 1032.

The zoarium is multilamellar, branched or massive. The zooecia are short and expand rapidly.

*Genotype.—Reptomulticava heteropora* Römer, 1839.

*Range.*—Neocomian, Miocene.

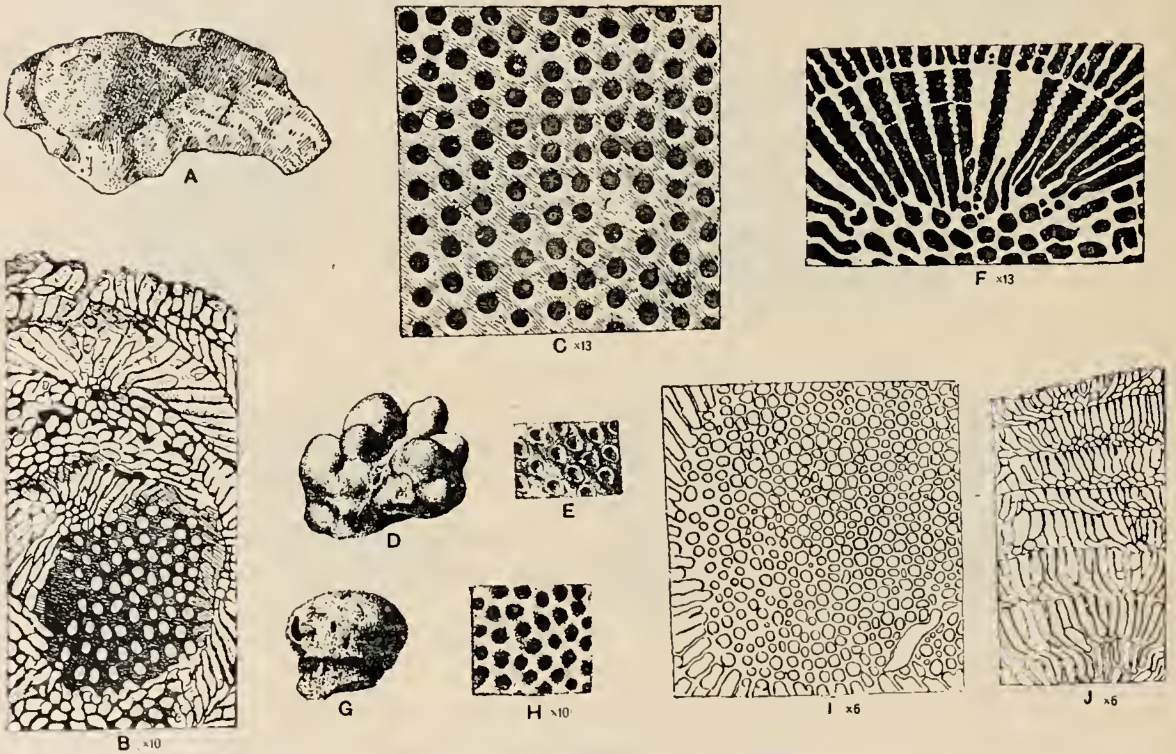


FIG. 221.—Forma *Reptomulticava* D'Orbigny, 1852.

A–C. *Reptomulticava heteropora* Römer, 1839. A. Zoarium, natural size, from the Neocomian of Germany. B. Section showing the multilamellar structure, × 10. C. Portion of the surface, × 13.

D, E, F. *Reptomulticava lobosa* Keeping, 1883. D, E. Zoarium, natural size, and portion of the surface enlarged, from the Lower Greensand of England. (After Keeping, 1883.) F. A vertical section across part of a zoarium, × 13.

G–J. *Reptomulticava fungiformis* Gregory, 1909. G. Zoarium, natural size, from the Lower Greensand of England. H. Portion of the surface, × 10. I. Transverse section across a zoarium, × 6. J. Vertical section across the same zoarium, × 6. (A–C, F–J, after Gregory, 1909.)

### Genus DEFRANCIOPORA Hamm, 1881.

1881. *Defranciopora* HAMM, Die Bryozoen des Maastrichter Ober-Senon. Part 1, Die Cyclostomen Bryozoen, Berlin, p. 39.

"The zoarium is formed of several saucer-shaped or discoid subcolonies in a vertical series. The apertures cover the upper, outer rim of the subcolonies; the lower exposed surface of each subcolony is covered by a calcareous layer (epizoarium). The zooecia on the upper surface are radially arranged around a central area of crowded apertures." (Gregory, 1909.)

*Genotype.—Defranciopora* (*Defrancia*) *cochloidea* Hagenow, 1851. Maastrichtian.

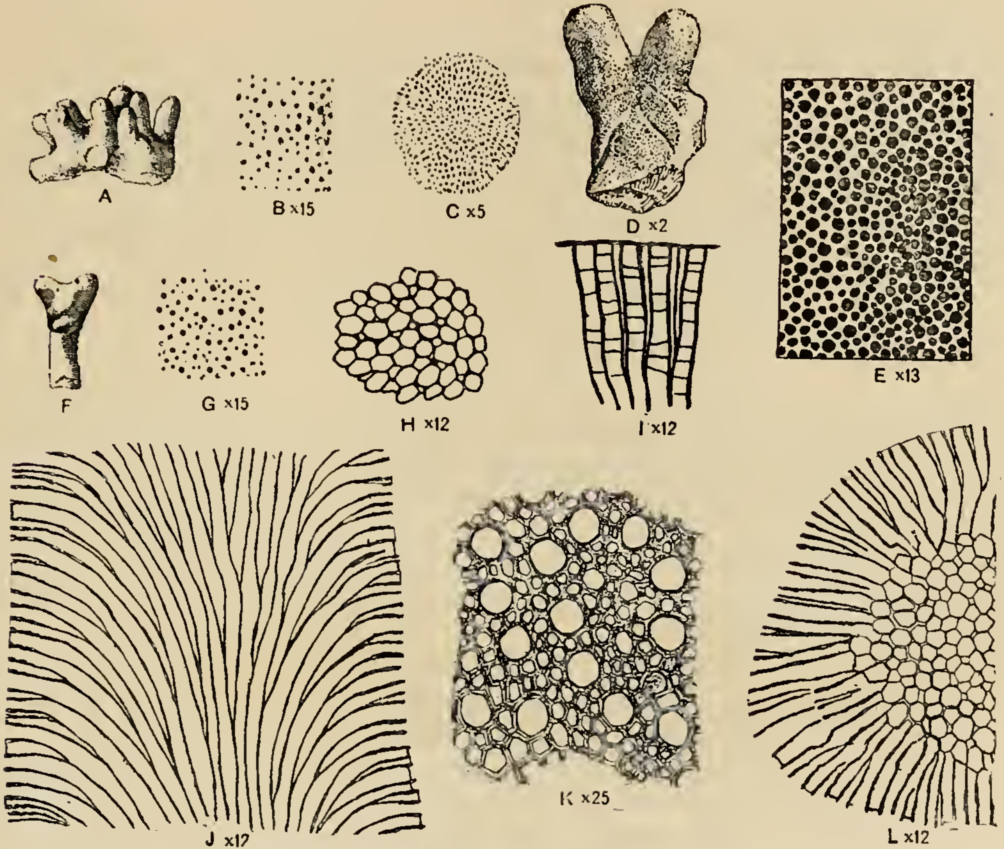


Fig. 222.—Forma *Heteropora* de Blainville, 1830.

A–G. *Heteropora cryptopora* Goldfuss, 1827. A. Zoarium, natural size. B, C. Portion of the surface, × 15 and × 5. (Figs. A–C after Hagenow, 1851.) D. A zoarium, × 2. E. Portion of the surface of the same zoarium, × 13. (Figs. D, E after Gregory, 1909.)

F, G. Zoarium of *Heteropora cryptopora* var. *tenera* Hagenow, 1851, and surface, × 15. (After Hagenow, 1851.)

H, I. *Heteropora conifera* Lamouroux, 1821. H. Transverse section through central zooecia, × 12. I. Longitudinal section through marginal zooecia, × 12, showing diaphragms and mesopores. (After Gregory, 1896.)

J, K, L. *Heteropora pelliculata* Waters, 1879. Longitudinal, tangential, and transverse thin section.

### Genus HETEROPORA Blainville, 1830.

1830. *Heteropora* de Blainville, Dictionnaire des Sciences naturalles, vol. 60, p. 381.

The tubes are cylindrical and long. Mesopores are present. The zoarium is massive or branched.

*Genotype.—Heteropora* (*Ceriopora*) *cryptopora*, Goldfuss, 1827.

*Range.*—Neocomian-Recent.

### HETEROPORA TECTA Ulrich, 1901.

Plate 104, figs. 14–20.

1901. *Heteropora ? tecta* Ulrich, Maryland Geological Survey, Eocene, p. 210, pl. 59, figs. 15, 16.

*Description.*—The zoarium is subcylindrical, solid or hollow. The orifices are orbicular and measure 0.10 mm. in diameter. The mesopores are polygonal, wide open, as large as the tubes. The tubes have vesicular walls at their extremity.

The small number of specimens found does not permit a more complete study. The various aspects of this species are shown in Ulrich's figures, which we produce, and in our new illustrations.

*Occurrence.*—Lowest Eocene (Bryozoan bed at base of Aquia formation): Upper Marlboro, Maryland (rare).

*Plesiotype.*—Cat. No. 65458, U.S.N.M.

### HETEROPORA ALVEOLATA, new species.

Plate 111, figs. 1–4.

*Description.*—The zoarium is massive and gives forth cylindrical branches. The apertura is large, hexagonal, and measures 0.16 mm. in diameter. The mesopores are irregular, polygonal, and are often closed by a calcareous pellicle. In sections, the tubes are cylindrical, traversed by diaphragms which become very numerous at their extremity in the region of the mesopores; the walls are quite thick and are formed of a continuous series of very large vesicles. The mesopores are long and have diaphragms.

| | | |
|---|---|---|
| *Measurements.*— | Diameter of the apertures | 0.16 mm. |
| | Distance between the apertures | 0.30–0.40 mm. |
| | Diameter of the branches | 3.00 mm. |

*Affinities.*—The diaphragms are so numerous that they give to the longitudinal section an alveolar aspect absolutely characteristic and very peculiar. However, such a structure is not rare in the Paleozoic formations. The section does not always cut exactly across the mesopore; when it cuts only through the wall it reveals a complicated structure resulting from the coalescence of the sectioned vesicles.

This species differs from *Heteropora ovalis* in the form of its aperture and in the great number of its diaphragms.

*Occurrence.*—Midwayan (Clayton limestone): Mabelvale, near Little Rock, Arkansas (rare).

*Holotype.*—Cat. No. 65254, U.S.N.M.

### HETEROPORA OVALIS, new species.

Plate 150, figs. 1–6.

*Description.*—The zoarium is free, branched, arborescent or dichotomous; the branches are cylindrical. The apertures are somewhat *oval*, slightly salient, and measure 0.10 mm. in diameter. The mesopores are numerous and polygonal. In sections the tubes are cylindrical, the walls are not vesicular. The mesopores are short, regular and parietal.

| | | |
|---|---|---|
| *Measurements.*— | Diameter of the orifices | 0.10 mm. |
| | Distance between the orifices | 0.50 mm. |
| | Diameter of the branches | 2.00 mm. |

*Affinities.*—This is a very disconcerting species. The tubes are cylindrical and yet the walls are not vesicular; they are simply separated by a sort of small canal resulting from the disappearance of the ectocyst; this is the habitual arrangement of the club-shaped tubes. The zoarial walls are regular as in the zoarial form *Petalopora*, and sometimes lamellar (in transverse section) as in *Hornera*. The mesopores are regular, parietal as in the forms *Petalopora and Sparsicavea*, which also have the club-shaped tubes.

This mingling of peculiar characters of the different families appears to indicate that this species must be ovicelled. Unfortunately we have not found many specimens of it.

This species differs from *Parascosoecia consimilis* Ulrich, 1882, in a greater diameter of the orifice (0.10 and not 0.08 mm.) in its solid and never hollow branches, in its much less numerous and shorter mesopores, and in its cylindrical tubes.

It differs from *Parleiosoecia jacksonica*, in which the exterior aspect is identical, in its solid branches, its much shorter mesopores, and its cylindrical tubes.

Although very close to *Heteropora subreticulata* Reuss, 1869, it differs from it in the exterior aspect of the mesopores, which, however, do not conform to the published figures.

*Occurrence.*—Lower Jacksonian (Moodys marl): Jackson, Mississippi (rare).

Middle Jacksonian: Three and one-half miles north of Grovania, Georgia (rare); one-half mile southeast of Georgia Koalin Company's Mine, Twiggs County, Georgia (rare).

*Cotypes.*—Cat. No. 65371, U.S.N.M.

### HETEROPORA AMOENA De Gregorio, 1890.

Plate 113, figs. 16–18.

1890. *Entalophora amoena* De Gregorio, Monographie de la Faune Eocenique de l'Alabama et surtout de celle de Claiborne de l'étage Parisien, Annales de Géologie et de Paléontologie, livr. 8, p. 240, p. 39, fig. 21.

*Description.*—The zoarium is free, subcylindrical, hollow, ornamented with large lateral and alternate apophyses, forming pseudobranches. The orifices are orbicular, widely spaced, and measure 0.10 mm. in diameter. The mesopores are numerous, irregular, polygonal. The tubes are cylindrical.

*Affinities.*—We believe that this species is *Entalophora amoena* de Gregorio, 1890, for it has the same lateral apophyses and the same cellular surface. To be certain of the determination the originals should be examined, but this has not been possible.

This species differs from *Heteropora ovalis* in its orbicular orifices and in its zoarial apophyses.

*Occurrence.*—Claibornian (Gosport sand): One mile southwest of Rockville, Clarke County, Alabama (rare).

Lower Jacksonian (Moodys marl): Jackson, Mississippi (very rare).

*Plesiotype.*—Cat. No. 65433, U.S.N.M.

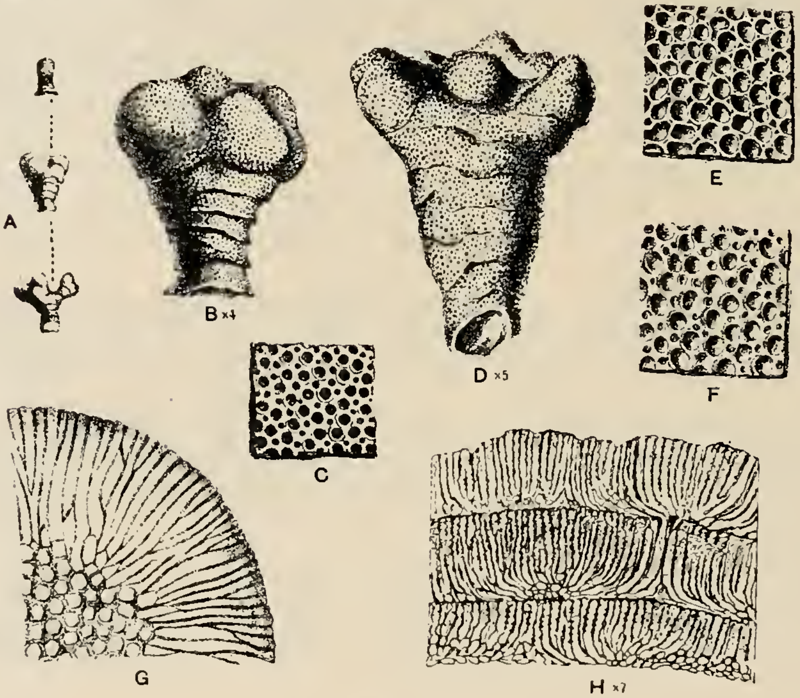


Fig. 223.—Forma *Multicrescis* D'Orbigny, 1852.

A–G. *Multicrescis variabilis* D'Orbigny, 1852. A. Different forms of the zoarium, natural size. B. A zoarium, × 4, showing the superposed layers of tubes. C. Portion of the surface much enlarged. (A–C after Novak, 1877.) D. A claviform zoarium, × 5. E, F. Two aspects of the surface enlarged, showing the zooecia varying in size according to that of the mesopores. G. Portion of transverse section through a zoarium. (D–G after D'Orbigny, 1852.)

H. *Multicrescis tuberosa* Römer, 1839. Part of vertical section, × 7, showing the beginning of an upper layer. (After Gregory, 1909.)

### Genus MULTICRESCIS D'Orbigny, 1852.

1852. *Multicrescis* D'Orbigny, Paléontologie française, Description des animaux invertébrés, Terrain Crétacé, vol. 5, p. 1073.

The zoarium is massive or branched and composed of successive thin layers of zooecia.

*Genotype.—Multicrescis variabilis* D'Orbigny, 1852.

*Range.*—Neocomian-Helvetian.

### Genus FUNGELLA Hagenow, 1851.

1851. *Fungella* HAGENOW, Die Bryozoen der Maastrichter Kreidebildung Cassel, p. 37.

The zoarium is simple and capitate. The peduncle is narrow, the head usually club-shaped.

*Genotype.—Fungella dujardini* Hagenow, 1851. Maastrichtian.

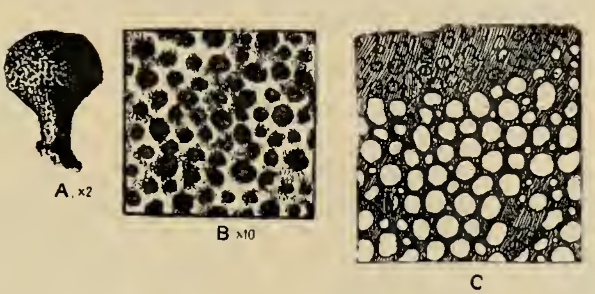


FIG. 224.—Genus *Fungella* Hagenow, 1851.

A–C. *Fungella dujardini* Hagenow, 1851. A. Side view of zoarium, × 2, from the Cretaceous at Maastricht, Holland. B. Upper surface, × 10. C. Horizontal section, × 10.

### Genus BIFLABELLARIA Pergens, 1894.

1894. *Biflabellaria* PERGENS, Nouveaux Bryozoaires du Crétacé du Limbourg, Bulletin de la Société Belge de Geologie, vol. 7, p. 172.

The zoarium is flabelliform, and consists of two layers on a median lamella.

*Genotype.—Biflabelleria apathyi* Pergens, 1894. Maastrichtian.

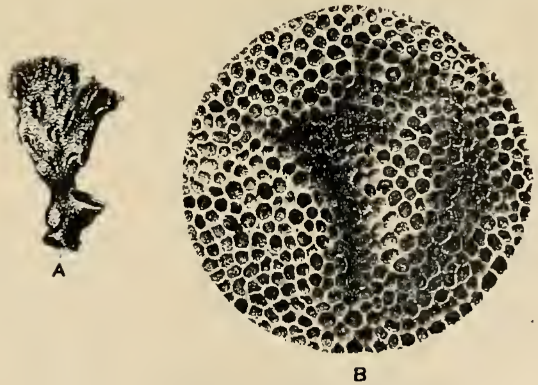


FIG. 225.—Genus *Biflabellaria* Pergens, 1894.

The flabelliform zoarium natural size and surface, × 17, of *Biflabellaria apathyi* Pergens, 1894, from the Maastrichtian of Holland. (After Pergens, 1894.)

## Division OVICELLATA.

The majority of species of American Tertiary Cyclostomata are provided with ovicells and therefore belong to the division of the Ovicellata. Waters has proposed the two subdivisions Parallelata and Rectangulata, which we have found valuable in classification. The following key is introduced for the determination of the families considered in this volume:

### KEY FOR THE DETERMINATION OF THE FAMILIES OF OVICELLATA.

| | | |
|---|---|---|
| 1. | The axis of the ovicell is perpendicular to the zooecial axis | 10 (Rectangulata). |
| | The axis of the ovicell is parallel to the zooecial axis | 2 (Parallelata). |
| 2. | The tubes adjacent to the ovicell are not disarranged | 3. |
| | The tubes adjcent to the ovicell are disarranged. The ovicell is formed before them | 8. |
| 3. | The ovicell is formed during the calcification of the adjacent tubes; it is isolated | 4. |
| | The ovicell is formed after the calcification of the adjacent tubes and is supported upon them | 5. |
| 4. | The oeciopore is not different from the zooecia apertures | Oncousoeciidae. |
| | The oeciopore is of different form | Crisiidae. |
| 5. | The longer axis of the ovicell is parallel to the zooecial axis | 6. |
| | The longer axis of the ovicell is not parallel to the zooecial axis | 7. |
| 6. | The oeciostome is terminal or subterminal | Terviidae. |
| | The oeciostome is lateral | Horneridae. |
| 7. | The ovicell is lobed (or lobate) | Tubuliporidae. |
| | The ovicell is not lobed | Diaperoeciidae. |
| 8. | The longer axis of the ovicell is perpendicular to the zooecial axis (Orthogonal development) | Plagioeciidae. |
| | The longer axis of the ovicell is parallel to the zooecial axis | 9. |
| 9. | A very large oeciopore is present (larva enormous) | Macroeciidae. |
| | Small oeciopore (ordinary larva) | Mecynoeciidae. |
| 10. | Ovicell lobate (or lobed) | Lichenoporidae. |
| | Ovicell nonlobate (or not lobed) | 11. |
| 11. | Ovicell not traversed by the tubes | Leiosoeciidae. |
| | Ovicell traversed by the tubes | 12. |
| 12. | Ovicell flat | Tretocycloeciidae. |
| | Ovicell globular, placed on the zoarial surface | Ascosoeciidae. |
| | Ovicell placed between the fascicles | Frondiporidae. |

The order of description of the various species is that of the geologic appearance as known at present.

### Subdivision PARALLELATA Waters, 1887.

The ovicell is developed parallel to the zooecial axis between the tubes (and not between the peristomies).

## Family ONCOUSOECIIDAE Canu, 1918.

The axis of the ovicell is parallel to that of the tubes. The ovicell is developed at the same time as the adjacent tubes, which are not disarranged in their respective position.

We have been able to recognize two genera, *Oncousoecia* Canu, 1918, in which the ovicell is a dilation of the entire exterior part of the tube, and *Peristomoecia* when the peristomie alone forms the ovicell.

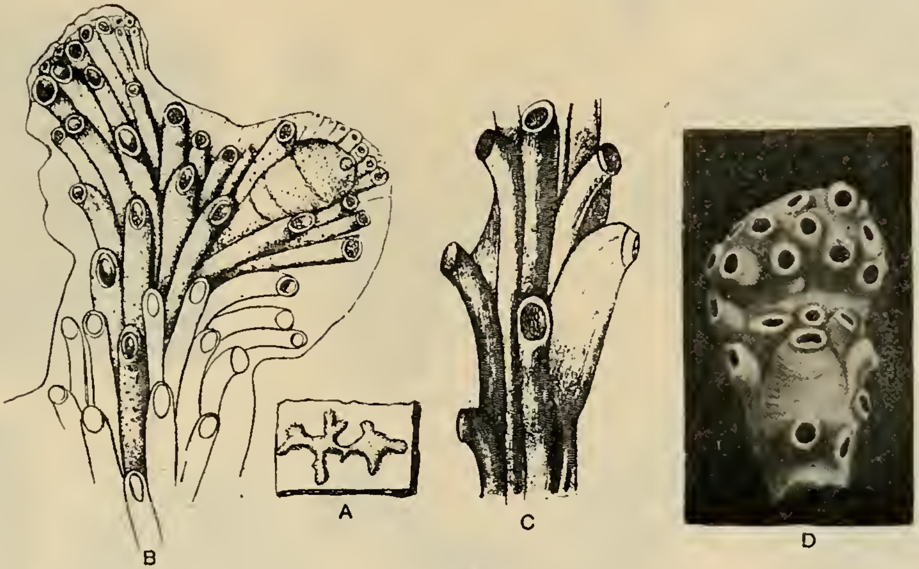


FIG. 226.—Genus *Oncousoccia* Canu, 1918.

A, B. Ovicelled zoarium natural size and enlarged of *Oncousoccia* (*Tubulipora*) *lobulata* Hincks, 1880. Recent.

C. Ovicelled zoarium of *Oncousoecia* (*Crisia*) *schmitzi* Pergens, 1890. Cenomanian.

D. Ovicelled zoarium, × 12, of *Oncousoccia* (*Filisparsa*) *bifurcata* Ulrich and Bassler, 1907. Cretaceous (Vincentown) of New Jersey.

### Genus ONCOUSOECIA Canu, 1918.

1918. *Oncousoccia* CANU, Les ovicelles des bryozoaires cyclostomes, Bulletin Société Géologique de France, ser. 4, vol. 16, p. 325.

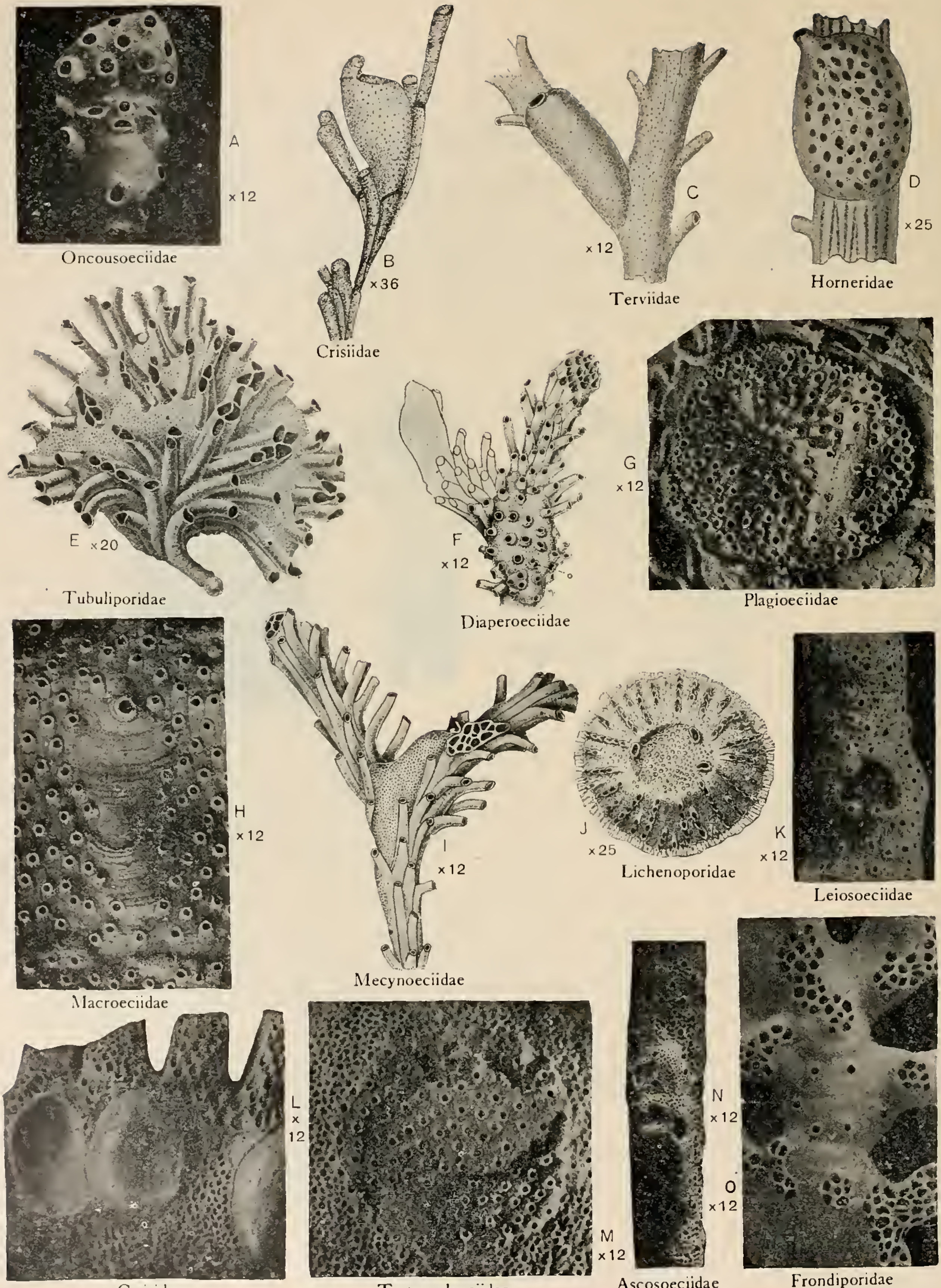
The ovicell is a dilation of the entire exterior visible part of the tube. The oeciostome is not turned toward the base. Fourteen tentacles.

*Genotype.*—*Tubulipora lobulata* Hincks, 1880.

*Range.*—Maastrichtian-Recent.

The exact limit between this genus and *Mecynoecia* is rather difficult to determine when one can not verify the abortion or the derangement of the adjacent tubes by dissection.

The ovicells are generally pyriform, but they are differently arranged; some have the point above and others have it below. This distinction does not appear


A
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Oncousoeciidae

Crisiidae

Terviidae

Horneridae

Tubuliporidae

Diaperoeciidae

Plagioeciidae

Macroeciidae

Mecynoeciidae

Lichenoporidae

Leiosoeciidae

Cytisidae

Tretocycloeciidae

Ascosoeciidae

Frondiporidae

Fig. 227.—Families of Ovicellata.

FIG. 226.—Families of Ovicellata.

A. Oncousoeciidae Canu, 1918. *Oncousoecia (Filisparsa) bifurcata* Ulrich and Bassler, 1907, × 12; Upper Cretaceous of New Jersey.

B. Crisiidae Johnston, 1847. *Crisidia (Crisia) franciscana* Robertson, 1910. (After Robertson.) Recent.

C. Terviidae, new family. *Tervia irregularis* Meneghini, 1844, × 12. (After Waters, 1888.) Recent.

D. Horneridae Gregory, 1899. *Hornera antarctica* Waters, 1904, × 25. (After Waters.) Recent.

E. Tubuliporidae Johnston, 1838. *Tubulipora flabellaris* Fabricius, 1780. (After Smitt, 1867.) Recent.

F. Diaperoeciidae Canu, 1918. *Diaperoecia intricaria* Busk, 1875. (After Harmer, 1915.) Recent.

G. Plagioeciidae Canu, 1918. *Plagioecia patina* Lamarck, 1816, × 12. Recent.

H. Macroeciidae Canu, 1918. *Macroecia (Diastopora) lamellosa* Michelin, 1845, Jurassic.

I. Mecynoeciidae Canu, 1918. *Mecynoecia (Entalophora) proboscidea* Milne-Edwards, 1838. (After Harmer, 1915.) Recent.

J. Lichenoporidae Smitt, 1866. *Lichenopora radiata* Andouin, 1826. (After Hincks, 1884.) Recent.

K. Leiosoeciidae, new family. *Leiosoecia (Multicrescis) parvicella* Gabb and Horn, 1860, × 12. Upper Cretaceous of New Jersey.

L. Cytisidae D'Orbigny, 1854. *Discocytis (Pelagia) eudesi* Michelin, 1844, × 12. Cenomanian of France.

M. Tretocycloeiidae, new family. *Partretocycloecia porosa* new species, × 12. Eocene of South Carolina.

N. Ascosoeciidae, new family. *Parascosoecia (Cavea) costata* D'Orbigny, 1851, × 12. Cretaceous of France.

O. Frondiporidae Busk, 1875. *Frondipora verrucosa* Lamouroux, 1821, × 12. Recent.

to us of generic value, for we are ignorant as to what difference in function it corresponds.

The zoarial form *Filisparsa* D'Orbigny, 1852, contains species showing several sorts of ovicells, particularly those pertaining to *Tervia* and *Oncousoecia*, but the great majority of the species show no ovicells. The two American species of *Oncousoecia* are precisely like *Filisparsa* in zoarial growth. To facilitate the determination we place this old genus at the end of this family and maintain it for the species showing no ovicells.

### ONCOUSOECIA VARIANS Reuss, 1869.

Plate 157, figs. 17–24.

1847. *Hornera biloba* Reuss, Die fossilen Polyparien des Wiener Tertiarbeckeus, Haidinger's naturwissenchaftliche, Abh. 2, p. 43, pl. 6, fig. 24 (fide Reuss).

1847. *Pustulopora anomola* Reuss, Idem. (p. parte), p. 41, pl. 6, figs. 19, 20, (fide Reuss).

1862. *Filisparsa tenella* Stoliczka, Oliogocäne Bryozoen vou Latdorf in Sternburg, Sitzungsberichte der k. Akademie der Wisseuschaften, Wien, vol. 45, p. 80, pl. 1, fig. 5.

1869. *Filisparsa varians* Reuss, Die fossilen Polyparien des Wiener Tertiärbeckens, Haldinger's naturwiss. Abhand, vol. 2, pp. 286, 291, pl. 35, figs. 14–15.

1869. *Filisparsa varians* Reuss, Zur fossilen Fauna der Oligocänschichten von Gäas, Sitzungsberichte der k. Akademie der Wissenschaften, Wien, vol. 59, p. 479 (34).

1877. *Filisparsa varians* Manzoni, I Briozoi fossili del Miocene d'Austria ed Ungheria, Denkschrifte der mathematisch-naturwissenschaftliche Klasse der k. Akademie der Wissenschaften, Wien, pt. 2, vol. 37, p. 9, pl. 7, fig. 27.

1877. *Hornera biloba* Reuss-Manzoni, I Briozoi fossili del Miocene d'Austria ed Ungheria, Denkschriften der mathematische-naturwissenschaftliche Klasse der k. Akademie der Wissenschaften, Wien, vol. 38, p. 9, pl. 7, fig. 25.

1877. *Filisparsa*, species Manzoni, Bryozoaires du pliocène supérieur de l'île de Rhodes, Mémoires Société géologique de France, ser. 3, vol. 1, p. 69, pl. 3. fig. 18.

1877. *Filisvarsa delvauxi* Pergens, Pliocäne Bryozoen von Rhodes, Annales des k. k. Naturhistorischen Hofmuseums, Wien, vol. 2, p. 6.

1877. *Filisparsa varians* Pergens, Note preliminaire sur les Bryozoaires fossiles des environs de Kolosvar, Annales Société royale malacologique Belgique, vol. 22, p. 6.

1889. *Filisparsa delvauxi* Pergens, Note succincte sur les Bryozoaires du Miocène de la Russie méridionale, Bulletin Société royale malacologique Belgique, vo. 24, p. 2.

1891. *Filisparsa varians* Neviani, Contribuzione alla conoscenza dei briozoi fossili italiaui, Briozoi postpliocenici del sottosuolo di Livorno, Bolletino Società geologica italiana, vol. 10, p. 139 (43), pl. 4, fig. 21.

1892. *Filisparsa varians* Waters, North Italian Bryozoa, Pt. 2, Cyclostomata, Quarterly Journal Geological Society, vol. 47, p. 157.

1896. *Filisparsa varians* Pergens, Bryozoaires des environs de Buda, Bulletin Société belge de géologie, paleontologie et d'hydrologie, vol. 10, p. 362, fig. included.

1900. *Tubulipora (Filisparsa) varians* Neviani, Briozoi ueogenici delle Calabrie, Paleontographia italica, vol. 6, p. 234 (regional bibliography).

1904. *Tubulipora (Filisparsa) varians* Neviani, Briozoi fossili di Carrubare, Bolletino Società geologica Italiana, vol. 23, p. 548 (sep. 46).

1908. *Filisparsa varians* Canu, Les Bryozoaires fossiles des Terrains du Sud-Ouest de la France, Bulletin de la Société geologique de France, ser. 4, vol. 8, p. 884.

1908. *Filisparsa varians* Beutler, Beitrag zur kenntnis des Bryozoenfauna der alterer Tertiarschichten des sudlichen Bäyern, II, Paleutographica, vol. 54, p. 233. pl. 24, figs. 14–16.

1909. *Filisparsa varians* Canu, Les bryozoaires tertiares des environs de Paris, Annales de Paleontologie, vol. 4, p. 115, pl. 14, figs. 6, 7, 8.

1913. *Filisparsa varians* Canu, Contributions a l'étude des Bryozoaires fossiles, pt. 5, Bulletin de la Société géologique de France, ser. 4, vol. 13, p. 125.

1914 *Filisparsa varians* Canu, Les bryozoaires fossiles des Terrains du Sud-Ouest de la France, Bulletin de la Société géologique de France, ser. 4, vol. 14, p. 473.

| | | |
|---|---|---|
| *Measurements.*— | Diameter of the peristome | 0.24–0.28 mm. |
| | Zooecial width | 0.30 mm. |
| | Distance between the peristomes | 1.00 mm. |
| | Width of the branches | 1.25 mm. |
| | Separation of the peristomes | 1.00 mm. |
| | Length of the peristomie | 0.30 mm. |

*Variations.*—The ovicell of this species was long ago discovered by Canu in a specimen from the Priabonian strata of the Vicentin, but a figure of it was not published until 1916. It is pyriform, the point below; the oeciostome is transverse and of the same diameter as that of an ordinary tube. This ovicell must be extremely rare, as we have not observed it on our large number of American Vicksburgian specimens.

The tubes are porous; the length of the peristomie very inconstant. In longitudinal or transversal section, the thickness of the exterior wall is very great.

*Affinities.*—The micrometric measurements are rather close to *Filisparsa ingens*, but the present species differs from it in a greater zooecial length and especially in its branches, which are only half as large.

*Occurrence.*—Vicksburgian (Marianna limestone): West bank Conecuh River, Escambia County, Alabama (very common); Salt mountain, 5 miles south of Jackson, Alabama (common); near Claiborne, Monroe County, Alabama (common); Murder Creek, east of Castlebury, Conecuh County, Alabama (very common).

*Geological distribution.*—Lutetian of Paris, the Pyrenees, Bavaria (Canu): Priabonian of the Vicentin (Reuss, Waters), of Transylvania (Pergens); Latdorfian of Germany (Stoliczka); Rupelian (=Stampian) of the southwest of France; Burdigalian of Gard (Collection of Canu); Helvetian of Gard (Collection of Canu) and of Italy (Seguenza); Tortonian of Italy (Seguenza), of Austria-Hungary (Reuss), of Russia (Pergens); Zanclean of Italy (Seguenza); Plaisancian of Italy (Seguenza); Astian of Italy (Seguenza), of southern France (Canu); Sicilian of Italy (Neviani); Quaternary of Italy (Neviani).

*Habitat.*—Mediterranean (Waters).

*Plesiotypes.*—Cat. No. 65402, U.S.N.M.

### ONCOUSOECIA QUINQUESERIATA, new species.

Plate 157, figs. 9–16.

*Descriptions.*—The zoarium has the *Filisparsa* growth, thin, bifurcated with short branches; the dorsal is smooth and the tubes are there visible longitudinally. The tubes are long, distinct, convex, arranged in *five* longitudinal rows, curved upward into a long, very oblique peristomie; the peristome is thin and orbicular. The ovicell is large, salient, pyriform, the point below, placed at the extremity of a branch; the oeciostome is elliptical, transverse, salient, of the same diameter as the tubes.

| | | |
|---|---|---|
| *Measurements.*— | Diameter of the peristome | 0.16 mm. |
| | Distance between the peristomes | 0.80–1.00 mm. |
| | Separation of the salient tubes | 0.90 mm. |
| | Separation of the nonsalient tubes | 0.76 mm. |
| | Length of the peristomie | 0.30 mm. |
| | Width of the branches | 0.50 mm. |

*Variations.*—The two series of lateral tubes open on the side and they are sometimes even completely turned around so that they open in the plane of the dorsal.

The peristomies opening nearly at the same height form very irregular kinds of verticells. On other branches, they are arranged in quincunx.

*Affinities.*—This species is very characteristic and very easy to determine. Some branches are similar to *Filisparsa bini*, but the present species differs in the presence of its five longitudinal rows of tubes and in the greater diameter of the peristomes (0.16 and not 0.12 mm.).

*Occurrence.*—Vicksburgian (Marianna limestone): One mile north of Monroeville, Alabama (rare); west bank Conecuh River, Escambia County, Alabama (rare).

Vicksburgian (Byram marl): Byram, Mississippi (common).

Vicksburgian (Red Bluff clay): One-fourth mile west of Woodward, Wayne County, Mississippi (very rare).

*Cotypes.*—Cat. Nos. 65400, 65401, U.S.N.M.

### PERISTOMOECIA, new genus.

The peristomie alone is enlarged to form the ovicell.

*Genotype.*—*Stomatopora divergens* Waters, 1904.

*Range.*—Recent.

Other species of this genus are:

*Proboscina lamourouxi* Savigny-Audouin, 1826.

*Proboscina boryi* Savigny-Audouin, 1826.

### Forma FILISPARSA D'Orbigny, 1853.

1853. *Filisparsa* D'Orbigny, Déscription des animaux invertébrés Terrain Crétacé Paléontologie française, vol. 5, p. 814.

The zoarium consists of linear, ribbonlike branches, which are erect. The branches dichotomize and may anastomose. The base is expanded. Zooecia open in one face only. The apertures are irregularly distributed. (After Gregory, 1899.)

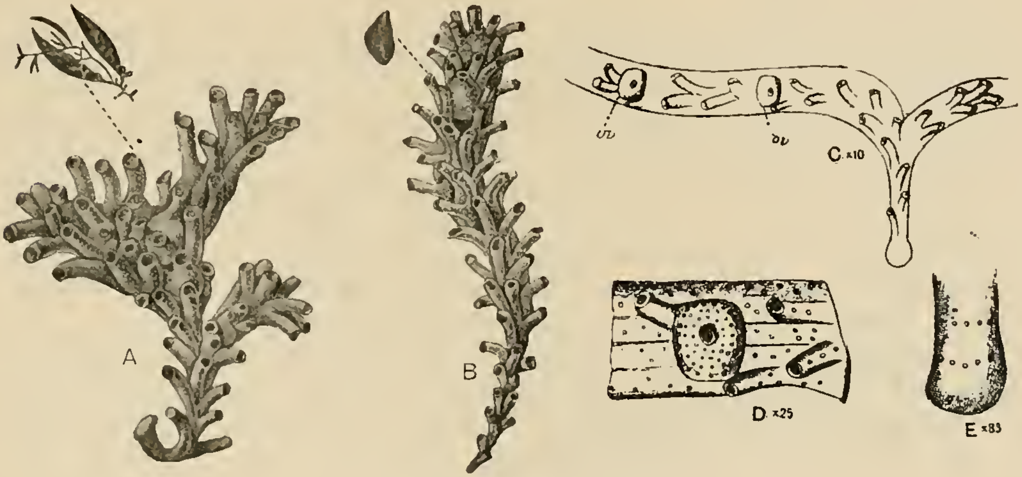

Fig. 228.—*Peristomoecia*, new genus.

A. Ovicelled zoarium natural size and enlarged of *Peristomoecia* (*Proboscina*) *boryii* Savigny Audouin, 1826. Recent.

B. Ovicelled zoarium of *Peristomoecia* (*Proboscina*) *lamourouxi* Savigny-Audouin, 1826. Recent.

C–E. *Peristomoecia* (*Stomatopora*) *divergens* Waters, 1904. C. Ovicelled zoarium (*ov*, ovicell), × 10. D. View, × 25, showing ovicell developed all around the free peristomie. E. Protoecium, × 85. Recent.

*Genotype.*—*Filisparsa neocomiensis* D'Orbigny, 1853.

Zoarial forms of the type described as *Filisparsa* occur in several distinct families, but unfortunately ovicells on species with this method of growth are still rare. When the ovicell appears on the noncellular posterior face the species belongs to *Tervia* Jullien, 1883, but if on the anterior face it occurs as an elongated median sack formed by the dilation of the terminal part of a tube. Species of the latter type form the genus *Oncousoecia* Canu, 1918. The species without ovicells much resemble those of *Oncousoecia* and for that reason we placed the zoarial form *Filisparsa* in the Oncousoeciidae.

#### FILISPARSA FALLAX, new species.

Plate 142, figs. 1–11.

*Description.*—The zoarium is filiform, slightly compressed, formed of two to three longitudinal rows of tubes. The tubes are little visible, convex, very finely striated transversally, cylindrical. The peristome is thin, orbicular or elliptical.

| | | |
|---|---|---|
| *Measurements.*— | Diameter of the peristome | 0.16 mm. |
| | Distance between the peristomes | 1.00 mm. |
| | Width of the branches | 0.40 mm. |

*Variations.*—This species is quite *deceiving*, as it closely simulates the abundant and widespread *Mecynoecia proboscidea* Milne-Edwards, 1838; but it has only a single celluliferous face. At Jackson, Mississippi, the specimens are more often biserial: at the locality near Monroevlle, Alabama, they are triserial. The tubes are rarely verticellate.

*Affinities.*—This species differs from *Filisparsa laxata* which has the same peristomial diameter, in its much smaller branches and in the number of its longitudinal rows of tubes which are only two to three.

*Occurrence.*—Lower Jacksonian (Moodys marl): Jackson, Mississippi (very common).

Middle Jacksonian: One-half mile southeast of Georgia Kaolin Company's Mine, Twiggs County, Georgia (rare); 12 miles southeast of Marshallville, Georgia (rare).

Upper Jacksonian (Ocala limestone): West bank Sepulga River, Escambia County, Alabama (very rare).

Vicksburgian (Marianna limestone): One mile north of Monroeville, Alabama (very common).

*Cotypes.*—Cat. Nos. 65325, 65326, U.S.N.M.

### **FILISPARSA INGENS**, new species.

Plate 142, figs. 12–21.

*Description.*—The zoarium is formed of *large* dichotomous branches, pluriserial and compressed; the dorsal is ornamented with large, transverse wrinkles. The tubes are distinct, very convex, arranged in very regular quincunx; the peristome is thick, orbicular, oblique.

| | | |
|---|---|---|
| *Measurements.*— | Diameter of the peristome | 0.20–0.24 mm. |
| | Distance between the peristomes | 0.80 mm. |
| | Separation of the peristomes | 1.00–1.20 mm. |
| | Width of the branches | 1.5–2.00 mm. |

*Variations.*—The great number of specimens collected, and chiefly their large size, has permitted us to make numerous sections for study. In transversal section the great thickness of the frontal walls is to be observed. In longitudinal section the tubes are short and issue on the dorsal at different heights; a short peristomie is often developed. The ablation of the dorsal shows the habitual lozenge-shaped areas formed by the projection of the tubes on the plane of the dorsal. The tangential section of the frontal shows the usual tremocysts of the Cyclostomata. The tangential section of the dorsal shows the same structure.

*Occurrence.*—Middle Jacksonian: Wilmington, North Carolina (very common; near Lenuds Ferry, South Carolina (common); Eutaw Springs South Carolina (common).

Vicksburgian (Marianna limestone): Salt Mountain, 5 miles south of Jackson, Alabama (very rare).

*Cotypes.*—Cat. No. 65327, U.S.N.M.

### FILISPARSA BINI, new species.

Plate 159, figs. 1–7

*Description.*—The zoarium is formed of filiform, sinuous, dichotomous, very little compressed branches, whose dorsal is very finely striated transversally. The tubes are distinct, convex, much elongated, arranged alternately in *pairs* on each side of the longitudinal axis, terminated by a narrowed peristomie, bent upward and salient; the peristome is thin and orbicular.

*Measurements.*—

| | |
|---|---|
| Diameter of the peristome | 0.12 mm. |
| Distance between the peristomes | 1.20–1.60 mm. |
| Diameter of the tubes | 0.18–0.20 mm. |
| Width of the branches | 0.38 mm. |

*Affinities.*—The tubes which form each pair have their peristomes close together but not adjoining; they do not therefore form lines as in *Idmonea bialternata* Gregory, 1893. The present species differs from *Filisparsa fallax* not only in this very important character, but also in its smaller peristomial diameter (0.12 and not 0.16 mm.).

*Occurrence.*—Vicksburgian (Red Bluff clay): Seven and one-half miles southwest of Bladen Springs, Alabama (rare).

Vicksburgian (Marianna limestone): One mile north Monroeville, Alabama (rare).

*Cotypes.*—Cat. Nos. 65406, 65407, U.S.N.M.

### FILISPARSA GRACILIS, new species.

Plate 159, figs. 8–11.

*Description.*—The zoarium is formed of *slender*, rectilinear branches bifurcated at a very acute angle, compressed, formed of three longitudinal rows of tubes. The tubes are distinct, cylindrical, hardly curved at their extremity, finely striated transversally and irregularly placed; the peristome is thin, orbicular or elliptical.

*Measurements.*—

| | |
|---|---|
| Diameter of the peristome | 0.16 (0.14–0.18 mm.). |
| Distance between the peristomes | 0.60–0.80 mm. |
| Width of the branches | 0.40 mm. |

*Affinities.*—This species differs from *Filisparsa bini* in its rectilinear, not sinuous, branches and in its shorter peristomial distance (0.80 and not 1.20 mm.). In the number of longitudinal rows, its affinities are chiefly with *Filisparsa fallax;*

but it differs from it in its very acute bifurcations and in a smaller distance between the peristomes (0.80 and not 1.00 mm.).

*Occurrence.*—Vicksburgian (Red Bluff clay): Seven and one-half miles southwest from Bladen Springs, Alabama (common).

*Cotypes.*—Cat. No. 65408, U.S.N.M.

### FILISPARSA TYPICA Manzoni, 1877.

Plate 159 figs. 12–18.

1821. *Hornera opuntia* Defrance, Dictionnaire des Sciences naturalles, vol. 21, p. 432.

1877. *Filisparsa typica* Manzoni, I Briozoi fossili del Miocene d'Austria ed Ungheria, Denkschriften der mathematische-naturwissenschaften Klasse der k. Akademie der Wissenschaften, Wien, pt. 3, vol. 38, p. 10, pl. 8, fig. 30.

1895. *Tubulipora* (*Filisparsa*) *typica* Neviani, Briozoi fossili della Farnesina e Monte Mario presso Roma, Palaeontographia Italica, vol. 1, p. 132 (56).

1909. *Filisparsa typic* Canu, Bryozoaires tertiaires des environs de Paris, Annales de Paleontologie, vol. 4, p. 115, pl. 14, figs. 25, 26.

1913. *Filisparsa typica* Canu, Contributions à l'étude des Bryozoaires fossiles, Bulletin de la Société Geologique de France, ser. 4, vol. 13, p. 127.

| | | |
|---|---|---|
| *Measurements.*— | Diameter of the peristome | 0.20 mm. |
| | Distance between the peristomes | 0.60–74 mm. |
| | Distance between the transverse rows | 0.50 mm. |
| | Separation of the peristomes | 0.56–0.60 mm. |

*Variations.*—Usually the peristomes are grouped in transverse rows to the number of three to six; they are not adjacent when the peristomie is developed. This peristomie is rather short, moreover, and where it is a little reduced the peristomes are adjacent and the tubes show as pseudo fascicles, whose separation is 0.50 mm. The peristomes arranged in quincunx are a little more widely spaced, their distances being from 0.60 to 0.74 mm.; this arrangement is always very irregular. The zone of growth is large and triangular.

There are in the Canu collection more than 200 specimens of this species from the faluns of Touraine, none of which shows an ovicell. However, according to certain indications, it is possible that the ovicell, if it exists, is of the type of *Diaperoecia.* It is also possible that in this and similar species the larva is developed in an ordinary tube in the vicinity of the tentacular sheath.

*Occurrence.*—Vicksburgian (Marianna limestone): Salt Mountain, 5 miles south of Jackson, Alabama, (rare); west bank of Conecuh River, Escambia County, Alabama (very common); deep well, Escambia County, Alabama (very rare); near Claiborne, Monroe County, Alabama (rare); Murder Creek, east of Castlebury, Conecuh County, Alabama (common).

Vicksburgian (Red Bluff clay): Seven and one-half miles southwest from Bladen Springs, Alabama (very rare).

*Geologic distribution.*—Lutetian of the Paris Basin (Canu); Burdigalian of Gard (Canu); Helvetian of Touraine (Canu) and of the Rhone valley (Canu); Tortonian of Austria-Hungary (Manzoni); Sicilian of Italy (Neviani).

*Plesiotypes.*—Cat. Nos. 65485, 65409, U.S.N.M.

### **FILISPARSA SIMULATOR**, new species.

Plate 159, figs. 19–28.

*Description.*—The zoarium is formed of rectilinear branches much compressed and pluriserial. The tubes are distinct, arranged in irregular quincunx or in transverse or oblique rows; they are terminated by a short upward bent peristomie; the peristome is thin, orbicular or elliptical. The dorsal is transversally striated.

| | | |
|---|---|---|
| *Measurements.*— | Diameter of the peristome | 0.16 mm. |
| | Distance between the peristomes | 0.40 mm. |
| | Separation of the peristomes | 0.50 mm. |
| | Width of the branches | 1.00 mm. |

*Variations.*—The arrangement of the peristomes is quite variable, being sometimes in quincunx, and occasionally in oblique rows, when the species *simulates Idmonea.* More often, they are grouped in transverse rows and the specimens resemble *Filispersa typica* Manzoni 1877 but *F. simulator* differs in its smaller micrometric dimensions (D=0.16 and not 0.20 mm.).

*Occurrence.*—Vicksburgian (Marianna limestone): One mile north of Monroeville, Alabama (very common).

*Cotypes.*—Cat. No. 65410, U.S.N.M.

### **FILISPARSA ATOMICULA**, new species.

Plate 157, figs. 25, 26.

*Description.*—The zoarium is *very small* and formed of rectilinear hairlike, triserial branches. The tubes are very small, distinct, wrinkled transversally, arranged in irregular quincunx, terminated by an upward bent peristomie; the peristome is thick and orbicular, salient.

| | | |
|---|---|---|
| *Measurements.*— | Diameter of the peristome | 0.10 mm. |
| | Diameter of the apertura | 0.07 mm. |
| | Distance between the peristomes | 0.30–0.50 mm. |
| | Separation of the peristomes | 0.30–0.36 mm. |
| | Width of the branches | 0.30 mm. |

This is the smallest of the American species of *Filisparsa* and occurs very rarely.

*Occurrence.*—Vicksburgian (Marianna limestone): One mile north of Monroeville, Alabama (very rare).

*Holotype.*—Cat. No. 65403, U.S.N.M.

### **FILISPARSA LAXATA**, new species.

Plate 160, figs. 1–4

*Description.*—The zoarium is formed of much compressed branches *enlarged* at the bifurcations, pluriserial. The tubes are distinct, cylindrical, finely striated transversally, arranged in regular quincunx, terminated by a peristomie upward bent and salient. The peristome is thin and orbicular.

| | | |
|---|---|---|
| *Measurements.*— | Diameter of the peristome | 0.14–0.16 mm. |
| | Distance between the peristomes | 0.70–1.00 mm. |
| | Separation of the peristomes | 0.60 mm. |
| | Width of the branches at the bifurcations | 1.20 mm. |

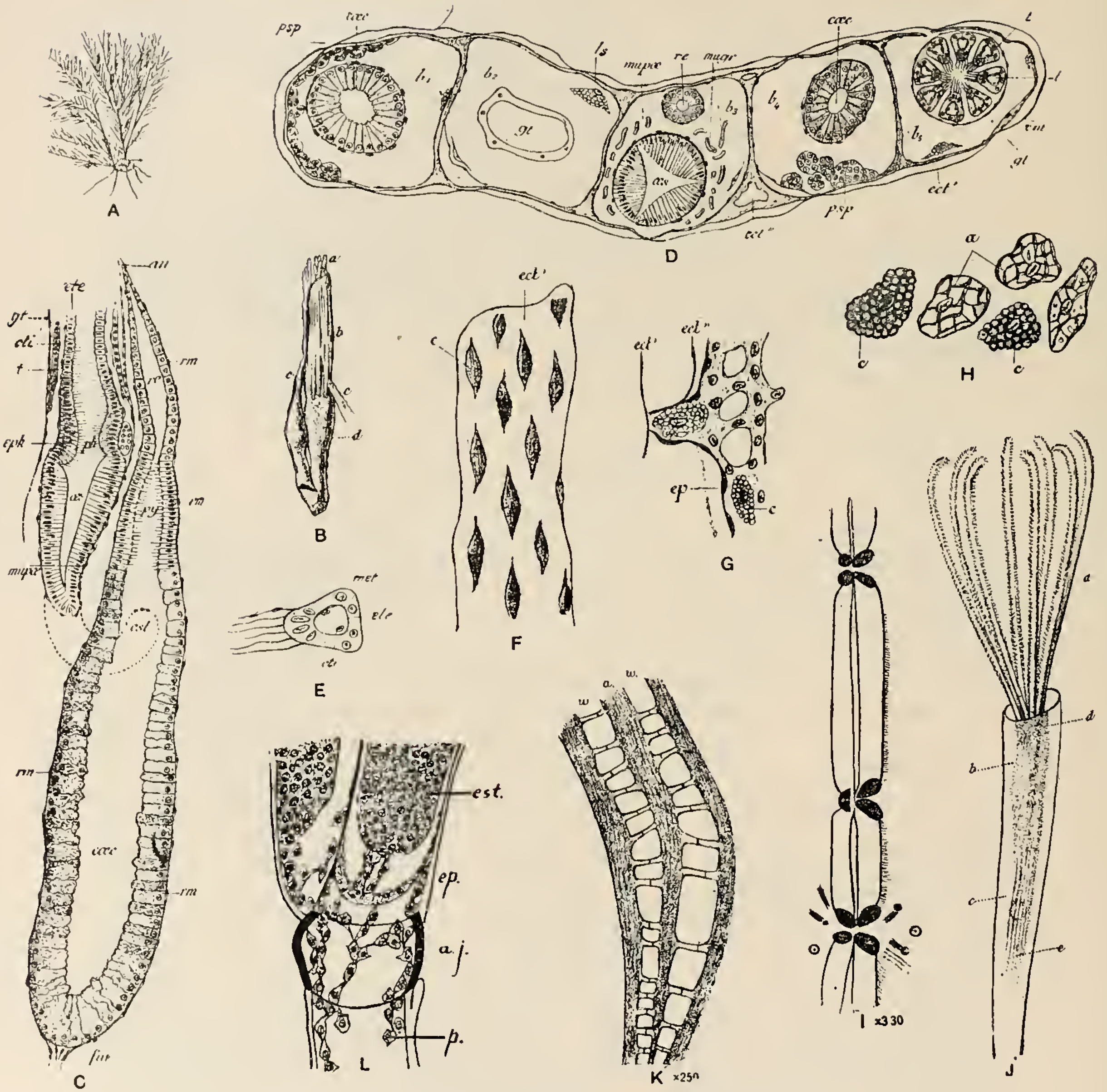
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Fig. 229.—Anatomy of the family Crisiidae Johnston, 1847.

FIG. 229.—Anatomy of the family Crisiidae Johnston, 1847.

A–I. *Crisia denticulata* Lamarck, 1836. A. Zoarium, natural size. B. Polypide isolated from the tube. (After Milne-Edwards, 1838.) *a*, tentacles; *b*, tentacular sheath; *c*, retractor muscle of the polypide; *d*, alimentary tube; *c*, anus. C. Portion of longitudinal section through the polypide. The contour of the cardiac region which has not been covered by the section is represented by stippling. D. Transverse section of a branch of the colony. E. Tentacle, transverse section. F. Strip of a tangential section of the ectocyst. Each of the pores corresponds to a spherular leucocyte. G. Portion of a longitudinal section of the wall of the ovicell. The spherular leucocytes are always abundant in the vicinity of the pores. H. Leucocytes of the general cavity of a zooecium. (C–H after Calvet, 1900.) *cocc*, stomachic coecum; *cl*, interzooecial partition; *cct*, ectocyst; *ect'*, *ect''*, the two cuticular leaves of the ectocyst; *cm*, mesenchyme; *ep*, endocyst; *cph*, epiderm of the pharynx; *cst*, stomach; *cte*, external tentacular epithelium; *cti*, internal tentacular epithelium; *gt*, tentacular sheath; *mupoe*, muscular perioesophagial fibers; *mugr*, great retractor muscle; *met*, anhistous membrane of the tentacles; *oes*, oesophagus; *ph*, pharynx; *py*, pylorus; *psp*, protospermatoblast morules; *re*, rectum; *sm*, mesenchymatous lining of the polypide; *t*, tentacles. I. Section through the inner wall of a zooecium showing the connectons from zooecum to zooecum (*c*) × 330. (After Waters, 1914.)

J. *Crisia geniculata* Milne-Edwards, 1878. Polypide with the tentacles evaginated. (After Milne-Edwards, 1838.) *a*, tentacles garnished with vibratile cilia; *b*, stomach; *c*, intestine; *d*, anus; *e*, retractor muscle of the polypide.

K. *Crisia elongata* Milne-Edwards, 1838. Proximal end of zooecium, showing connection (*a*) to the two neighboring zooecia, through numerous tubes in which there is a septum in the middle of the zooecial walls (*w*), × 250. (After Waters, 1914.)

L. *Crisidia cornuta* Ellis, 1755. Decalcified segment. (After Pergens, 1899.) *a. j.*, link of juncture; *est*, stomach; *ep*, ectocyst; *p*, parenchyme.

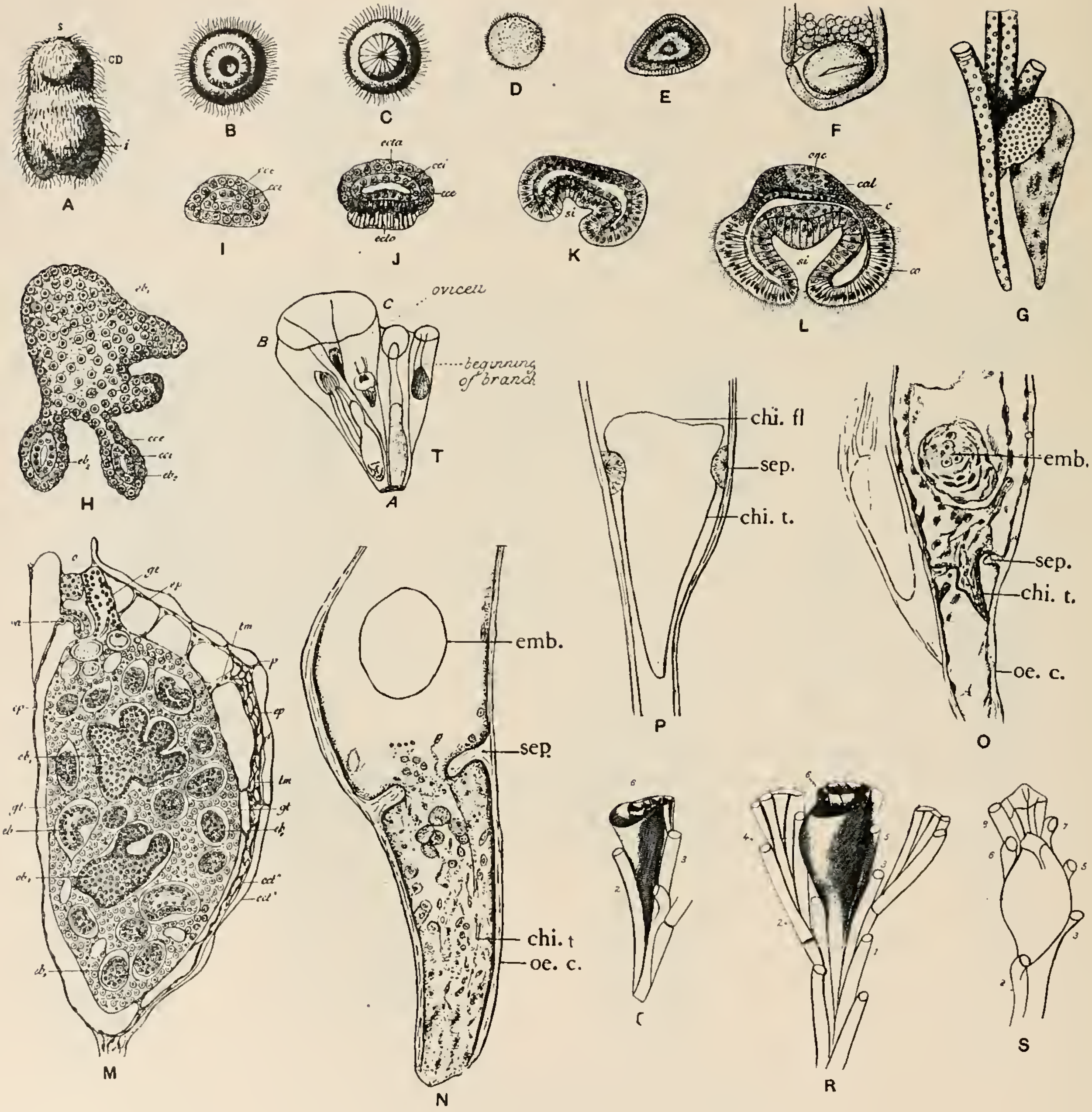
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FIG. 230.—Family Crisiidae Johnston, 1847.

Fig. 230.—Family Crisiidae Johnston, 1847.

A–G. *Crisia eburnea* Ellis, 1755. A. Larva seen in profile. B. Aboral pole of larva. C. Oral pole. (A–C after Barrois, 1877.) *CD*, digestive cavity; *s*, oral face or from the vestibule. D. E, F. Embryos (after Smitt, 1865). G. Ovicell showing internal sac containing the primary embryos (after Smitt, 1865).

H–M. *Crisia denticulata* Milne-Edwards, 1838. H. Section of a primary embryo. Two of the lobes of this embryo are provided with a central cavity and the two cellular distinct layers. The constriction which must cause the separation of the rest of the embryos is rather marked. I, J, K, L. Meridian sections showing different stages in the development of the secondary embryo. M. Sagittal section of an ovicell inclosing two primary embryos and a rather large number of secondary embryos. *cal*, calotte; *ccc*, external cellular layer of the secondary embryos; *cci*, internal cellular layer of the secondary embryo; *co*, coronna; *eb*, primary embryo; $eb_2$, secondary embryo; *ect' ect''*, the two cuticular leaves of the ectocyst; *ect a*, aboral ectocyst; *ecto*, oral ectocyst; *ep*, endocys; *gt*, tentacular sheath; *onc*, central nervous organ of the embryo; o, orifice; *p*, pores; *si*, internal sac; *tm*, mesenchymatous tissue; *va*, valvule.

N. *Crisidia* (*Crisia*) *franciscana* Robertson, 1910. Cross section of an ovicell in an older stage of growth showing a relatively large embryo (*emb.*) and a septum (*sep*) whose growth is about completed. The chitinous tube (*chi. t*) growing down into the ooecial cone (*oe. c*) shows only at intervals in this section.

O. A cross section of an ovicell containing a developing embryo on a young stage (*emb*) and showing, also, an early stage in the growth of the septum (*sep*).

P. *Crisia edwardsiana* D'Orbigny, 1839. Diagrammatic representation of a cross-section of the ovicell showing the cellular septum (*sep*) with the chitinous tube (*chi. t*) and chitinous floor (*chi. fl*). (O, P. After Robertson, 1910.)

Q–S. *Crisia ramosa* Harmer, 1891. Sketches showing development of ovicell. The ovicell has in each case been numbered 4 in order to admit of ready comparison between the three stages.

T. *Crisia eburnea* Ellis, 1755. A young internode decalcified, with a developing ovicell. (Q–T after Harmer, 1893.) A. B. C. Summits of an imaginary triangle.

*Affinities.*—This species differs from *Filisparsa gracilis* in the greater distance of the peristomes (more than 0.70 mm.) and in the presence of multiserial and claviform branches. The young branches are triserial.

*Occurrence.*—Vicksburgian (Marianna limestone): Murder Creek, east of Castlebury, Conecuh County, Alabama (rare); west bank Conecuh River, Escambia County, Alabama (rare).

Vicksburgian (Red Bluff clay): Seven and one-half miles southwest from Bladen Springs, Alabama (rare).

*Cotypes.*—Cat. Nos. 65411, 65412, U.S.N.M.

### FILISPARSA BISERIATA, new species.

Plate 157, fig. 27.

*Description.*—The zoarium is formed of thin, rectilinear, *biserial* branches. The tubes are little distinct, alternate, terminated by a short peristomie; the peristome is thin and orbicular.

| | | |
|---|---|---|
| *Measurements.*— | Diameter of the peristome | 0.10 mm. |
| | Distance between the peristomes | 0.44 mm. |
| | Width of the branches | 0.24 mm. |

*Affinities.*—This species greatly resembles *Crisia*, but the zoarium does not appear articulated. D'Orbigny called zoarial forms of this kind *Unicrisia*. The species differs from *Filisparsa fallax*, which is often biserial, in its smaller peristomial diameter (0.10 and not 0.16 mm.).

*Occurrence.*—Vicksburgian (Marianna limestone): West bank Conecuh River, Escambia County, Alabama (very rare).

*Holotype.*—Cat. No. 65404, U.S.N.M.

#### KEY TO THE DETERMINATION OF AMERICAN SPECIES OF THE ONCOUSOECIIDAE.

| | | |
|---|---|---|
| 1. | Zoarium biserial | 2. |
| | Zoarium pluriserial | 3. |
| 2. | Peristome of 0.10 mm | *Filisparsa biseriata.* |
| | Peristome of 0.16 mm | *Filisparsa fallax.* |
| 3. | Tubes arranged in alternate series, branches sinuous | *Filisparsa bini.* |
| | Tubes arranged in transverse series | 4. |
| | Tubes arranged in quincunx | 5. |
| 4. | Peristome of 0.20 mm | *Filisparsa typica.* |
| | Peristome of 0.16 mm | *Filisparsa simulator.* |
| 5. | Peristome of 0.10 mm | *Filisparsa atomicula.* |
| | Peristome of 0.20–0.24 mm., large branches | *Filisparsa ingens.* |
| | Peristome of 0.24–0.28 mm | *Oncousoecia varians.* |
| | Peristome of 0.16 mm | 6. |
| 6. | Branches always triserial | 7. |
| | Branches pluriserial | 8. |
| 7. | The peristomes are distant, 1.00 mm | *Filisparsa fallax.* |
| | The peristomes are distant from 0.60 to 0.80 mm | *Filisparsa gracilis.* |
| 8. | Lateral tubes turned toward the dorsal | *Oncousoecia quinqueseriata.* |
| | Zoarium much compressed with claviform branches | *Filisparsa laxata.* |

## Family CRISIIDAE Johnston, 1847.

*Anatomical bibliography.*—1877. Barrois, Recherches sur l'embryologie des Bryozoaires, Travaux de l'Institut de Zoologie, Lille, fasc. 1, pl. 3, figs. 22, 23, 24.—1838. Milne-Edwards, Memoire sur les Crisies, les Hörneres et plusieurs autres Polypes, Annales des Sciences Naturelles, Zoologie, ser. 2, vol. 9, pp. 1–11, pl. 6, fig. 1; pl. 7, fig. 1.—1891. Harmer, On the British species of Crisia, Quarterly Journal of the Microscopical Society, new ser., vol. 32, pl. 12.—1893. Harmer, On the occurrence of embryonic fission in Cyclostomatous Polyzoa, Quarterly Journal of Microscopical Science, new ser., vol. 34, pls. 1–3.—1900. Calvet, Contributions â l'histoire naturelle des Bryozoaires ectoproctes marins, Travaux Institut zoologie Université Montpellier Stat Marit, Catle, new ser., Memoire No. 8, pl. 7, fig. 15; pl. 8, fig. 22; pl. 10, figs. 15–20.—1914. Waters, The Marine fauna of British East Africa and Zanzibar, Proceedings of the Zoological Society of London, p. 834, pls. 55, figs. 5, 6.—1916. Waters, Some Species of Crisia, Annals and Magazine of Natural History, ser. 8, vol. 18, p. 470, pl. 16.

The ovicell is regular, symmetrical, sacciform, isolated. The oeciopore is terminal, as large as the aperture of the tubes. The zoarium is articulated and radicated.

This family is often erroneously attributed to Busk, 1859, but it was established in 1847 by Johnston under the name of Crisiadae. The terminology adopted has no importance from the standpoint of priority, since scientific observation alone ought to be considered.

The best known genus of this family is *Crisia*. Perhaps it will be necessary to erect a distinct genus for the *Crisia denticulata* group which is without a salient oeciostome. It is evident that here the function of the escape of the larvae has become different.

We possess rather good anatomical material of this family but unfortunately the determination of the specimens is always laborious and often doubtful.

The bathymetric distribution of the Crisiidae is deceiving. They live in fact on marine algae and after death fall to greater depths often very far from their place of origin.

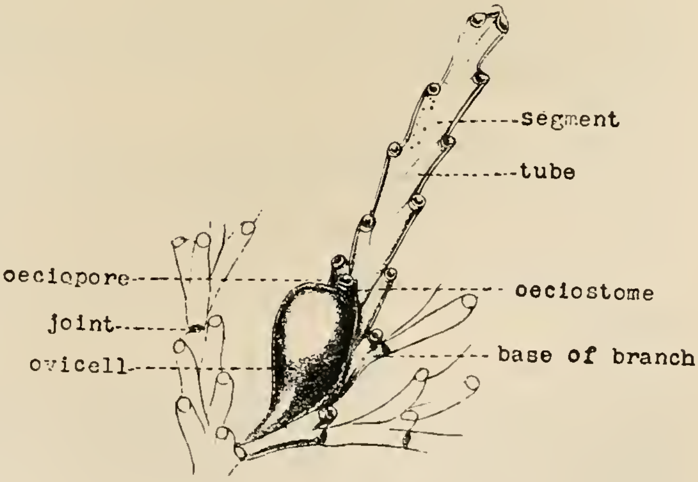

Fig. 231.—Genus *Crisia* Lamouroux, 1816.

A branch showing the terminology in this genus.

### Genus CRISIA Lamouroux, 1816.

1816. *Crisia* Lamouroux, Historie des Polypiers Coralligènes flexibles, p. 136.

The zooecia are biserial.

*Genotype.*—*Crisia* (*Sertularia*) *eburnea* Linnaeus, 1758.

*Range.*—Lutetian. Recent.

### CRISIA HÖRNESI Reuss, 1847.

Plate 141, figs. 1–4.

1847. *Crisia hörnesi* Reuss, Die fossilen Polyparien des Wiener Tertiärbeckens, Haidinger's naturwissenschaftliche Abhandlungen, pt. 2, Wien, p. 54, pl. 7, fig. 21; pl. 11, fig. 28.
1847. *Coelophyma glabrum* Reuss, Die fossilen Polyparien des Wiener Tertiärbeckens, Haidinger's naturwissenschaftliche Abhandlungen, pt. 2, p. 99, pl. 11, fig. 28.
1866. *Crisia hörnesi* Reuss, Die Foraminiferen, Anthozoen und Bryozoen des Deutschen Septarienthones, Ein Beitrag zur fauna der mitteloligocänen Tertiärschichten. Denkschriften der k. Akad. der Wissensch., Wien, vol. 25, p. 191 (75), pl. 11, fig. 12.
1867. *Crisia hörnesi* Reuss, Die fossile Fauna der Steinsalzablagerung von Wieliczka in Galizien, Sitzungsberichte der k. Akademie der Wissenschaften, Wien, vol. 55. Abtheil. 4, p. 121, no. 30.
1877. *Crisia hörnesi* (Reuss) Manzoni, I Briozoi fossili del Miocene d'Austria ed Ungheria, Denkschriften der k. Akad. der Wissensch., Wien, vol. 25, p. 191 (75), pl. 11, fig. 12; pt. 2, vol. 37, p. 4, pl. 1, fig. 3.
1889. *Crisia hörnesi* Terrigi, I Macco di Palo, p. 104, pl. 2, fig. 5 (fide Neviani).
1900. *Crisia hörnesi* Neviani, Bryozoi Terziari e Posterziari della Toscana, Bolletino d. Societá Geologica italiana, vol. 19, p. 27.
1900. *Crisia hörnesi* Neviani, Briozoi neogenici della Calabrie, Paleontographa italiana, vol. 6, p. 224 (110) (local bibliography).
1891. *Crisia hörnesi* Neviani, Contribuzione alla conoscenza dei briozoi fossili italiani. Briozoi postpliocenici del sottosuolo di Livorno, Bolletino della Societá geologica italiana, vol. 10, p. 131 (35) pl. 4, fig. 3.
1896. *Crisia hörnesi* Neviani, Briozoi neozoici di alcune localita d'italia, Bolletino della Societá Romana per gli Studi Zoologici, pt. 3, vol. 5, p. 123 (22).
1909. *Crisia hörnesi* Canu, Bryozoaire des terrains tertiaires des environs de Paris, Annales Paleontologie, vol. 4, p. 103, pl. 12, fig. 12.

| | | |
|---|---|---|
| *Measurements.*— | Distance between the apertures | 0.24–0.30 mm. |
| | Width of the zooecium and of the peristome | 0.06–0.08 mm. |
| | Width of segments | 0.30 mm. |

The ovicell is very salient, somewhat pyriform. The oeciopore is placed in the vicinity of the zoarium and the oeciostome is not salient. It is similar to that of *Crisia denticulata* Lamarck, 1812,[1] in which the measurements are also almost identical.

*Affinities.*—This species differs from *Crisia denticulata* Lamarck, 1812, in having 16 or 17 tubes to the segments (in place of 11) and in the interapertural distance less or equal to the zoarial width, but never greater.

It differs from *Crisia cribraria* Stimpson, 1853, in a lesser number (17 or 18) of tubes on the segments.

It differs from *Crisia lowei* in its larger zooecial dimensions (0.08 and never 0.06 mm.).

---

[1] *Crisia elongata* Harmer, 1915, to which that author adds *Crisia denticulata* Waters, 1910, is not the *Crisia elongata* Lamarck, 1812. The micrometric measurements given are slightly less than those of *Crisia denticulata* as Milne-Edwards who figured Lamarck's type wrote in 1838: "Elle ressemble beaucoup á la Crisie deteleé, mais s'en distingue par ses branches plus grêles, ses cellules tubuleuses *beaucoup plus petites* et par la longueur considérable des espaces comprises entre deux etranglements ou articulations (=segments); le nombre des individees dont se compose une de ces portions du polypier s'élevè ici à environ vingt. . . ." The figure of Milne-Edwards, magnified 24 diameters, is excellent and gives rise to no confusion. The species of Harmer-Waters must therefore be determined anew.

*Occurrence.*—Lower Jacksonian (Moodys marl): Jackson, Mississippi (common).

Vicksburgian (Red Bluff clay): Seven and one-half miles southwest of Bladen Springs, Alabama (rare).

*Geological distribution.*—Lutetian of Paris (Canu); Stampian of Germany (Reuss); Burdigalian of Gard (Canu); Helvetian of Herault (Canu), of Italy (Seguenza); Zanclean of Italy (Seguenza, Neviani); Tortonian of Italy, (Seguenza), of Germany (Reuss); Astian of Italy (Seguenza); Sicilian of Italy (Neviani); Quaternary of Italy (Neviani).

*Plesiotypes.*—Cat. No. 65336, U.S.N.M.

### CRISIA EDWARDSI Reuss, 1847.

Plate 141, figs. 5–7.

1847. *Crisia edwardsi* Reuss, Die fossilen Polyparien des Wiener Tertiärbeckens. Haidinger's naturwissenschaftliche Abhandlungen, Wien, vol. 2, p. 53, pl. 7, fig. 20.

1851. *Crisia edwardsi* Reuss, Ein Beitrag zur Palaeontologie der Tertiärschichten Oberschlesiens, Zeitschrift der Deutschen Geologischen Gesellschaft, Berlin, vol. 3. p. 170.

1866. *Crisia edwardsi* Reuss, Die Foraminiferen, Anthozoen und Bryozoen des Deutschen Septarienthones, Ein Beitrag zur fauna der mitteloligocänen Tertiärschichten, Denk. der k. Akademie der Wissenschaften, Wien, vol. 25, p. 191 (75), pl. 11, fig. 16.

1867. *Crisia edwardsi* Reuss, Die fossile Fauna der Steinsalzablagerung von Wieliczka in Galizien, Sitzungsberichte der k. Akademie der Wissenschaften, Wien, vol. 55, Abtheil. 1, p. 122.

1896. *Crisia edwardsi* Reuss, Zur fossilen Fauna der Oligocänschichten von Gass, Sitzungsberichte der k. Akademie der Wissenschaften, Wien, vol. 59, Abth. 1, p. 33.

1869. *Crisia edwardsi* Reuss, Paläontologische Studien über die älteren Tertiärschichten der Alpen, Abth 2 Die fossilen Anthozoen und Bryozoen der Schichtengruppe von Crosaro, Sitzungsberichte der k. Akademie der Wissenschaften, Wien, vol. 58, Abth. 1, p. 67.

1877. *Crisia edwardsi* Manzoni, I Briozoi fossili del Miocene d'Austria ed Ungheria, Denkschriften der Math. natur. Classe der k. Akademie der Wissenschaften, Wien pt. 3, vol. 38, p. 111, pl. 1, fig. 2.

1879. *Crisia edwardsi* Seguenza, Le formazioni terziarie nella Provincia di Reggio, (Calabria), Reale Accademia dei Lincei, Memorie della Classe di Scienze Fisiche, Matematiche e Naturali, ser. 3, vol. 6, pp. 84, 132, 208, 296.

1900. *Crisia edwardsi* Neviani, Estratto della Palaeontographica Italica, Memoires di Palaeontographica, vol. 6, Briozoi neog. della Calabria, p. 224 (110).

1909. *Crisia edwardsi* Canu, Bryozoaires des terrains tertiaires des environs Paris, Annales de Paleontologie, vol. 2, p. 105, pl. 12, figs. 13, 14.

| | | |
|---|---|---|
| *Measurements.*— | Distance between the apertures | 0.30 mm. |
| | Width of zooecia including peristome | 0.08 mm. |
| | Zoarial width | 0.26–0.28 mm. |

Our measurements are smaller than those of the specimens from the Tertiary formations of the environs of Paris.

The characteristic of this species is that the distance between the apertures is greater than the width of the segments. But to be certain of the determination it is necessary to know the micrometric dimensions of the type and the nature of its ovicell, two features of which we are ignorant.

The peristomes are more salient laterally than in *Crisia hörnesi* Reuss, 1847, with which it is scarcely possible to confuse it.

*Occurrence.*—Middle Jacksonian: Near Lenuds Ferry, South Carolina (rare).

*Geological distribution.*—Lutetian of Paris (Canu); Priabonian of the Vicentin (Reuss); Rupelian (=Stampian) of Germany (Reuss) and of Gaas (Reuss); Burdigalian of Gard (Canu); Helvetian of Italy (Seguenza) and of Gard (Canu); Tortonian of Austria Hungary (Reuss) and of Italy (Seguenza); Zanclean of Italy (Seguenza); Astian of Italy (Seguenza).

Neviani in 1900 affirmed that this species lived in the Mediterranean. This is possible, but we have not yet sufficient proof of this fact.

*Plesiotypes.*—Cat. No. 65337, U.S.N.M.

### CRISIA CRIBRARIA Stimpson, 1853.

Plate 141, figs. 9–11.

1853. *Crisia cribraria* Stimpson, Synopses of the marine Invertebrata of Grand Manan or the region about the mouth of the Bay of Fundy, New Brunswick, Smithsonian Contributions to Knowledge, vol. 6, no. 5, p. 18.

1910. *Crisia cribraria* Osburn, The Bryozoa of Woods Hole Region, Bulletin of the Bureau of Fisheries, vol. 30, p. 215, pl. 18, fig. 7.

| | | |
|---|---|---|
| *Measurements.*— | Distance between the apertures | 0.24 mm. |
| | Width of zooecia, including peristome | 0.08 mm. |
| | Zoarial width | 0.28 mm. |

In the separation of the apertures, which is less than the zoarial width, this species is close to *Crisia hörnesi* Reuss, 1847. It differs from it in its micrometric dimensions, and especially in a larger number of tubes on the segments (27 in place of 18).

We have based our determination on Osburn's figure.

The ovicell is pyriform, salient; its occiopore is terminal and placed against the zoarial wall; it has no salient oeciostome.

*Occurrence.*—Lower Jacksonian (Moodys marl): Jackson, Mississippi (rare).

*Habitat*—Coasts of the United States (28 meters) at Crab-Ledge on Cape Cod, and of Canada.

*Plesiotypes.*—Cat. No. 65339, U.S.N.M.

### CRISIA LOWEI, new species.

Plate 141 fig. 8.

*Description.*—The segments are short and are formed of 14 to 15 lateral and alternate tubes. The peristomes are orbicular, somewhat salient laterally to one-half of their diameter; their separation is less than the zoarial width. The ovicell is pyriform.

| | | |
|---|---|---|
| *Measurements.*— | Distance between apertures | 0.20–0.24 mm. |
| | Diameter of the zooecia and peristome | 0.06–0.07 mm. |
| | Zoarial diameter | 0.28 mm. |
| | Number of tubes to a segment | 14–15 |

*Affinities.*—This species is very close to *Crisia hörnesi* Reuss, 1847, in the distance between its tubes, which is less than the zoarial width. It differs from it simply in the smaller micrometric measurements.

We dedicate this species to Mr. E. N. Lowe, State geologist of Mississippi, to whom we are indebted for many courtesies.

*Occurrence.*—Lower Jacksonian (Moodys marl): Jackson, Mississippi (very rare).[1]

*Holotype.*—Cat. No. 65338, U.S.N.M.

### Genus CRISIDIA Milne-Edwards, 1838.

1838. *Crisidia* Milne-Edwards, Mémoire sur les Crisies, les Hornéres et plusieurs autres Polypes, Annales des Sciences Naturelles, Zoologie, ser. 2, vol. 9, p. 11.

The zooecia are uniserial.

*Genotype.*—*Crisia* (*Sertularia*) *cornuta* Ellis, 1755.

*Range.*—Miocene-Recent.

This genus has not been recognized, but we are ignorant of the reasons. We have recognized it in the application of our fundamental principle: the genus is a natural one when any function operates in a different manner. Here the gemmation is different and more simple than in the genus *Crisia* Lamouroux, 1816.

## Family PLAGIOECIIDAE Canu, 1918.

The longitudinal axis of the ovicell is perpendicular to the zooecial axis. The ovicell is formed before the calcification of the neighboring tubes, the formation of which it hinders. The oeciostome is small.

This family is quite well characterized by the orthogonal development of the ovicell. In all the other families this development is directed parallel to the zooecial tubes. The generic divisions are hard to determine because of the variations of the oeciostome which is always difficult to discover as it is so small or so much like a tube. Often it is only by dissection of the ovicell that the oeciostome may be found with certainty; unfortunately the ovicelled specimens are still too rare in collections.

The principal known genera are *Plagioecia* Canu, 1918, and *Desmeplagioecia*, new genus. However, it is certain that the first of these genera will be dismembered later according to the function of evacuation of the larvae.

### Genus PLAGIOECIA Canu, 1918.

1918. *Plagioecia* Canu, Les ovicelles des bryozoaires cyclostomes, Bulletin de la Société Geologique, France, ser. 4, vol. 16, p. 327.

The ovicell is transversal. The oeciostome is small, equal to or less than the zooecial diameter. The tubes are isolated from each other. No adventitious tubes.

---

[1] We have found segments of *Crisia* in the Claibornian at Claiborne, Alabama, which are close to *Crisia subaequalis* Reuss, 1869, but which are, however, very poorly preserved. We have also found very beautiful specimens in the Vicksburgian, but unfortunately they were broken in transit through the mails.

*Genotype.—Plagioecia* (*Diastopora*) *patina* Lamarck, 1816.

*Range.*—Jurassic-Recent.

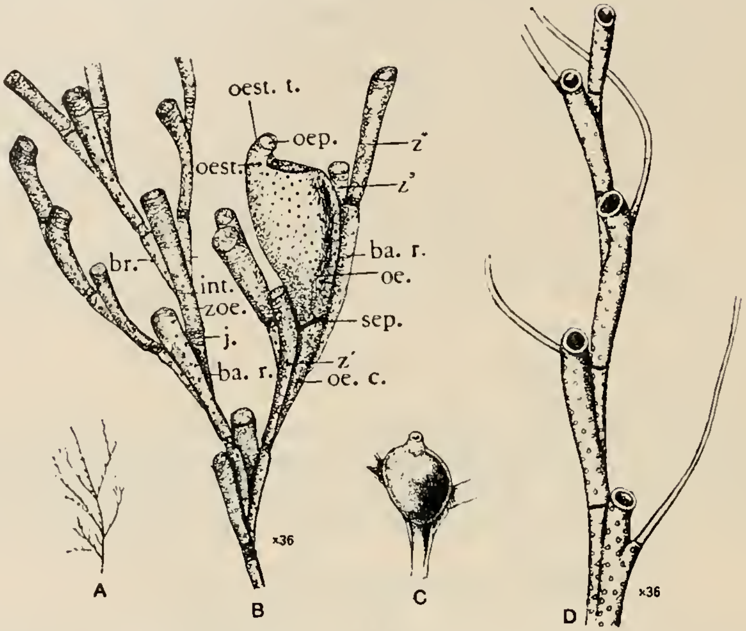

FIG. 232.—Genus *Crisidia* Milne-Edwards, 1838.

A. Zoarium natural size of *Crisidia* (*Sertularia*) *cornuta* Ellis, 1755.

B. Portion of a colony, × 36, of *Crisidia* (*Crisia*) *franciscana* Robertson, 1910, showing method of branching, and formation of ordinary and of ooecial internodes. The ordinary uniserial internode consisting of a zooecium (*zoe*) giving origin to two other zooecia (*br*). The (*oe*) the second member, the zooecium $z^3$, a third member. Arising from a basal ramus (*ba. r.*) on the third zooecium is a fourth zooecium ($z^4$), which serves to continue the branch upward. The prominent ooecium (*oe*) having a well developed tube (*oest. t.*) at its summit, bent slightly backward. (After Robertson, 1910.

C. Ovicell of *Crisidia cornuta* Ellis. (After Harmer, 1891.)

D. Branch of *Crisidia cornuta* Ellis, 1755, × 36, showing uniserial arrangement of zooecia. (A–H after Hincks, 1880.)

The other known species belonging to this genus are:

*Berenicea latomarginata* D'Orbigny, 1852. Piocene-Recent.
*Diastopora lactea* Jullien, 1884. Recent.
*Proboscina sarthaeensis* Pergens, 1890. Cenomanian.
*Mesenteripora compressa* Goldfuss, 1827. Cretaceous.
*Reticulipota obliqua* D'Orbigny, 1850. Cretaceous.
*Discosparsa clypeiformis* D'Orbigny, 1853. Turonian-Senonian.
*Entalophora ramosissima* D'Orbigny, 1850. Cenomanian-Coniacian.
*Diastopora echinata* Poeta, 1892. Cenomanian.
*Berenicea folium* Novak, 1877. Cenomanian.
*Berenicea archiaci* Haime, 1854. Jurassic.
*Berenicea diluviana* Lamouroux, 1821. Bathonian.
*Diastopora michelini* Blainville, 1830. Bajocian-Bathonian.
*Berenicea undulata* Michelin, 1846. Bajocian-Bathonian.

### PLAGIOECIA SUBRAMOSA Ulrich, 1901.

Plate 104, figs. 5, 6.

1901. *Fascipora subramosa* Ulrich, Maryland Geological Survey, Eocene, p. 207, pl. 19, figs. 1, 2.

*Description.*—Zoarium consisting of small flattened branches, varying from subcylindrical to flabellate, usually about 1.5 mm. in thickness. Ends of branches convex, occupied by the mouths of numerous subequal, thin-walled, angular tubes, usually about 0.12 mm. in diameter. Sides of branches with rather obscure transverse wrinkles and the apertures of the true or fully developed zooecia. The latter are somewhat scattered, though a tendency to arrangement in series—chiefly longitudinal—is commonly apparent. Zooecial apertures ovate, about 0.14 by 0.18 mm., with about five in 2 mm. Interapertural space as well as apertural covers, minutely punctate. In vertical fractures the tubes are shown to be very long and that they approach the surface very gradually. Ooecium, a mere inflation of the surface through which one or more of the zooecial tubes pass. In the general form of its zoarium this species agrees very well with *F. pavonina* (Michelin), D'Orbigny's type of the genus, but its zooecia are much smaller and not nearly so prominent.

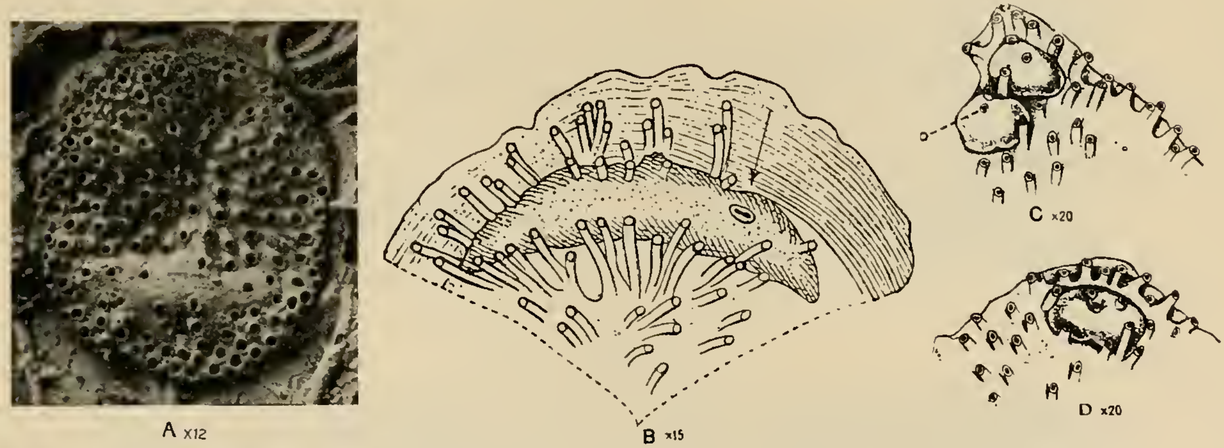

Fig. 233.—Genus *Plagioecia* Canu, 1918.

A. Complete ovicelled zoarium, × 12, of *Plagioecia patina* Lamarck, 1816, from the English channel.

B. Sketch, × 15, of *Plagioecia latomarginata* D'Orbigny, 1852. (After Neviani, 1905.)

C. Two views, × 20, of ovicelled portions of *Plagioecia sarniensis* Norman, 1864. (After Harmer, 1915.)

The above description by Ulrich is excellent, but *Fascipora*, to which he referred the species, is only a zoarial form and not a natural genus. Judging by the ovicell, this is a very typical *Plagioecia*.

*Occurrence.*—Lowest Eocene (Bryozoan bed at base of Aquia formation): Upper Marboro, Maryland (rare).

### PLAGIOECIA LOBATA, new species.

Plate 106, figs. 6—14.

*Description.*—The zoarium is formed of bilamellar, rounded and flabellate *lobes*, branched in the same plane. The tubes are indistinct, arranged in regular quincunx, ornamented with salient, widely spaced, and overlapping wrinkles. The peristome is little salient, thin, elliptical, often acuminate distally. The ovicell is large, globular, very convex, arranged transversely in the upper part of the lobe. The zone of growth is thick, but not very wide.

*Measurements.*—Diameter of the peristome.................... 0.10–0.12 mm.

*Variations.*—The lobes are very irregular in dimension; their base is more or less narrowed.

In tangential section we note that the tubes are perforated with the usual tremopores. Their arrangement in fusiform, elongate, lozenge-shape areas proves that their system of branching offers no peculiarity.

The irregularity of the transverse sections is occasioned by the unequal divergence of the tubes.

*Occurrence.*—Midwayan (Clayton limestone). Luverne, Crenshaw County, Alabama (very common); one mile west of Fort Gaines, Georgia (rare).

*Cotypes.*—Cat. Nos. 65422, 65423, U.S.N.M.

### PLAGIOECIA CLAVIOEDES, new species.

Plate 106, figs. 15, 16.

*Description.*—The zoarium is flabelliform and incrusts shells. The tubes are distinct, regularly *claviform* arranged in regular quincunx, the peristome is little salient, elliptical, horizontal. The ovicell is large, globular, little distant from the zoarial margin. The zone of growth is quite visible, but of little width and thickness.

*Measurements.*—
Diameter of the peristome................. 0.12 mm.
Distance between the peristomes.......... 0.30–0.40 mm.
Separation of the peristomes.............. 0.44–0.48 mm.

*Occurrence.*—Midwayan (Clayton limestone): One mile west of Fort Gaines, Georgia (very rare); Mabelvale, near Little Rock, Arkansas (rare).

*Holotype.*—Cat. No. 64424, U.S.N.M.

### PLAGIOECIA SUPERPOSITA, new species.

Plate 106, figs. 17, 18.

*Description.*—The zoarium incrusts terebratuloid brachiopods; it is formed of orbicular subcolonies adjacent and *superposed.* The tubes are little distinct, cylindrical, short, arranged in quincunx at the center and in radial rows on the margins, never bent upward; the peristome is thin, elliptical or orbicular, according to its obliquity. The ovicell is long, convex, parallel to the zoarial margins. The zone of growth is thick and is supported by the projecting basal lamella.

*Measurements.*—Diameter of the peristomes______________________ 0.13 mm.

*Affinities.*—In its zooecial arrangement this species is very close to *Plagioecia concreta*, but differs from it in its incrusting habit of growth, and in its somewhat smaller micrometric measurements.

The only specimen so far discovered has been figured and comparisons with other species are evidently provisional.

*Occurrence.*—Midwayan (Clayton limestone): Well at Brundidge, Alabama (very rare).

*Holotype.*—Cat. No. 65425, U.S.N.M.

### PLAGIOECIA BRUNDIDGENSIS, new species.

Plate 109, figs. 13, 14.

*Description.*—The zoarium incrusts terebratuloid brachiopods, in irregular lobes. The tubes are small, distinct, cylindrical, somewhat bent upward at their extremity; the peristome is thin, little salient, elliptical. The ovicell is very convex, transverse, short. The zone of growth is invisible.

| | | |
|---|---|---|
| *Measurements.*— | Diameter of the peristomes_______________ | 0.08–0.10 mm. |
| | Distance between the peristomes__________ | 0.28–0.34 mm. |
| | Separation of the peristomes_____________ | 0.28 mm. |

*Occurrence.*—Midwayan (Clayton limestone): Well at Brundidge, Alabama (very rare).

### PLAGIOECIA TUBIFER, new species.

Plate 112, figs. 9–12.

*Description.*—The zoarium creeps over shells or on algae and emits *tubular* hollow expansions. The tubes are indistinct, with porous surface, arranged in very irregular quincunx; the peristome is large, salient, very thin, orbicular. The ovicell is short, little convex, transverse, elliptical. The zone of growth is scarcely visible.

*Measurements.*—Diameter of the peristome__________________ 0.14–0.16 mm.

*Occurrence.*—Wilcoxian (Bashie formation): Woods Bluff, Alabama (rare).

*Cotypes.*—Cat. No. 65265, U.S.N.M.

### PLAGIOECIA CONCRETA, new species.

Plate 123, figs. 1–14.

*Description.*—The zoarium is free, unilamellar, formed of *aggregated* subcolonies, orbicular, adjacent, and superposed. The tubes are distinct, cylindrical, terminated by a short, oblique, peristome, slightly striated transversally, arranged in quincunx. The peristome is round and oblique, or horizontal and elliptical. The ovicell is large, arched, parallel to the zoarial margins, very convex. The zone of growth is narrow and somewhat thick on the aggregated zoaria; it is very wide on the simple zoaria.

| | | |
|---|---|---|
| *Measurements.*— | Diameter of the peristome | 0.12 mm. |
| | Distance between the peristomes | 0.30–0.40 mm. |
| | Separation of the peristomes | 0.52 mm. |

*Variations.*—The zoarial variations are very great. The simple zoaria are typical *Discosparsa* with large zoarial margins and wide zone of growth. The basal lamella is striated concentrically (fig. 4), sometimes pedunculate. Sometimes the zoaria are superposed in the form of *Domopora* (figs. 7, 14); but more often they are aggregated in a manner to form large colonies (*Multisparsa*) having a measurement of 2 centimeters in diameter. This zoarial proliferation occurs by rejuvenescence; each zoarium is emitted from a vigorous tube of another zoarium which thus serves as a pseudoancestrula. It is remarkable to note how an identical phenomenon is the cause of numerous zoarial forms as varied as they are absolutely unexpected.

On the zoarial margins, the tubes are close together and are grouped in radial rows and even in short fascicles (fig. 13) an arrangement similar to that in *Actinopora.*

The tubes are often closed by smooth diaphragms. According to Waters, this arrangement reveals a long peristomie, of which the diaphragm is the base. The aspect of our fossils is not therefore the real one.

The ablation of the basal lamella reveals the habitual lozenge-shaped areas, showing that the tubes grow one upon another from their lower dorsal (fig. 9).

The phenomenon of rejuvenescence begins always in a central zooecium (figs. 5, 6) prolonged more or less directly from the primitive zoarial ancestrula. In this kind of *Domopora*, the peristomie, well visible (figs. 10) in the median sections of the isolated zoaria, disappears completely (fig. 14).

Finally, it is not unusual to encounter incompletely developed ovicells (fig. 12).

This species is especially well developed at Wilmington, North Carolina, and Lenuds Ferry, South Carolina. The specimens from other localities are small and doubtful.

*Affinities.*—The simple and free forms differ from *Plagioecia discoidea* in which the tubes have the same diameter in that the tubes are grouped in radial rows on the zoarial margins and in the greater separation of the peristomes (0.52 and not 0.32 mm.).

*Occurrence.*—Middle Jacksonian; Near Lenuds Ferry, South Carolina (common); Wilmington, North Carolina (very common).

Upper Jacksonian (Ocala limestone): Chipola River, east of Marianna, Jackson County, Florida; Old Factory, about one and one-half miles above Bainbridge, Georgia (rare).

*Cotypes.*—Cat. No. 65303, U.S.N.M.

### PLAGIOECIA DIVAGANS, new species.

Plate 121, figs. 1–7.

*Description.*—The zoarium incrusts shells, bryozoa, and algae on their flat surfaces; it is orbicular or eccentric; the zone of growth is thick but rather narrow, with numerous incomplete tubes. The tubes are cylindrical, very erect and wide apart at the center, recumbent and very close together on the zoarial margins. The peristome is orbicular at the center, elliptical on the margins. The ovicell is large, transverse, smooth, quite convex.

| | | |
|---|---|---|
| *Measurements.*— | Diameter of the peristome | 0.10 mm. |
| | Distance between the peristomes | 0.30–0.40 mm. |
| | Separation of the peristomes | 0.40 mm. |

*Variations.*—This species sometimes emits subcolonies. The larva is affixed somewhat at hazard and the zoaria are then deformed by the irregularities of the substratum, which gives them the most varied aspects. Figure 5, plate 121, represents a multiple zoarium fixed on the radicell of an alga and which thus assumes a very aberrant form. The tubes are frequently closed by a calcareous compact, smooth lamella.

This species is well characterized, first, by the thickness of the zone of growth; second, by its tubes, which are more erect and more salient at the center than at the circumference; and, third, by its peristomes, which are very close to each other in the vicinity of the zoarial margins.

*Occurrence.*—Lower Jacksonian (Moodys marl): Jackson, Mississippi (rare). Middle Jacksonian: Wilmington, North Carolina (rare); near Lenuds Ferry, South Carolina (rare); Eutaw Springs, South Carolina (rare); Rich Hill, 5½ miles southeast of Knoxville, Crawford County, Georgia (very rare).

Vicksburgian (Marianna limestone): Three miles southwest of Vosburg, Jasper County, Mississippi (rare).

*Cotypes.*—Cat. Nos. 65297, 65298, U.S.N.M.

### PLAGIOECIA GLOBULOSA, new species.

Plate 115, figs. 2–6.

*Description.*—The zoarium is a cylindrical, hollow Entalophora; it incrusts very fine radicells at their ramifications. The tubes are little visible, somewhat convex, bordered by a very narrow thread; the peristome is oblique, elliptical, regular, little salient, thin. The ovicell is very large, *globular*, transverse, very salient, smooth.

| | | |
|---|---|---|
| *Measurements.*— | Diameter of the peristome and of the tubes | 0.14 mm. |
| | Distance between the orifices | 0.40–0.74 mm. |
| | Separation of the peristomes | 0.60–0.70 mm. |
| | Diameter of the branches | 1.2 mm. |

Almost all the tubes of our specimens are closed by a calcareous lamella. As the lamella of growth is very small, we must suppose that there is a long peristomie.

*Affinities.*—This species has the exterior aspect of *Mecynoecia quisenberryae*, but differs from it in its hollow zoarium with a threadlike cavity in its interior, in the absence of overlapping wrinkles upon the tubes, and in its ovicell which is larger and of a different form.

It differs from *Diastopora tubiformis* in which the zoarium is almost identical, in the absence of overlapping wrinkles on the tubes, and in the presence of a separating thread between the tubes.

*Occurrence.*—Middle Jacksonian (Castle Hayne limestone): Wilmington, North Carolina (rare).

*Cotypes.*—Cat. No. 65275, U.S.N.M.

### PLAGIOECIA LAMELLOSA, new species.

Plate 122, figs. 10–13.

*Description.*—The zoarium is unilamellar. The tubes are indistinct at their base, cylindrical, rectilinear, striated, terminated by a very oblique peristomie, arranged in quincunx; the peristome is orbicular and oblique or more often elliptical and horizontal. The ovicell is convex, transverse, in the form of a crescent whose convexity is proximal and not parallel to the zoarial margins. No zone of growth is visible.

| | | |
|---|---|---|
| *Measurements.*— | Diameter of the peristome | 0.12 mm. |
| | Distance between the peristomes | 0.50 mm. |
| | Separation of the peristomes | 0.58 mm. |

*Affinities.*—The difference between this species and *Diastopora striatisemota* is very slight; they perhaps represent the same species. The present species differs from it in its larger zooecial diameter (0.12 and not 0.10 mm.) and chiefly in the great separation of the peristomes (0.58 and not 0.40 mm.). This has the same ovicell as *Plagioecia botula*, but it differs from it in its peristome of 0.12 and not 0.16 mm. More numerous specimens will permit us perhaps to reunite these three species.

*Occurrence.*—Middle Jacksonian (Castle Hayne limestone): Wilmington, North Carolina (rare).

*Cotypes.*—Cat. No. 65429, U.S.N.M.

### PLAGIOECIA BOTULA, new species.

Plate 124, figs. 1, 2.

*Description.*—The zoarium is discoidal, incrusting shells, and emits flabelliform expansions. The tubes are distinct, long, cylindrical, or somewhat in the shape of a horn, bent upward at their extremity, arranged in regular quincunx, slightly striated, terminated by a short very oblique peristomie; the peristome is orbicular or elliptical when the peristomie is incomplete. The ovicell is rectilinear, convex in the form of a *sausage*. The zone of growth is invisible.

| | | |
|---|---|---|
| *Measurements.*— | Diameter of the peristomes (when not salient) | 0.12–0.16 mm. |
| | Distance between the peristomes | 0.40–0.60 mm. |
| | Separation of the peristomes | 0.40–0.50 mm. |

*Variations.*—A large number of specimens present in their inferior part two inexplicable fractures, always almost identically arranged and of the same size. We have figured them on plate 124.

*Affinities.*—The aspect of this species is similar to that of *Plagioecia hirta*, but differs from it in its tubes bent up a little (and not rectilinear), and more widely spaced in every sense.

*Occurrence.*—Middle Jacksonian (Castle Hayne limestone): Wilmington, North Carolina (rare).

Upper Jacksonian (Ocala limestone): Nine miles north of Ocala, Florida (very rare); Chipola River, east of Marianna, Jackson County, Florida (rare).

*Holotype.*—Cat. No. 65304, U.S.N.M.

### PLAGIOECIA HIRTA, new species.

Plate 124, figs. 3-11.

*Description.*—The zoarium incrusts shells and bryozoa; it is flabelliform, orbicular, rarely linear. The tubes are distinct, rectilinear, hornshaped, narrowed at the back, very slightly striated, arranged in regular quincunx, prolonged into a very oblique peristomie; the peristome is elliptical, horizontal, very thin, often sharply pointed distally. The ovicell is short, elliptical, not arched, placed near the zoarial margins. There is no visible zone of growth.

| | | |
|---|---|---|
| *Measurements.*— | Diameter of the peristome | 0.10 mm. |
| | Distance between the peristomes | 0.40 (0.30–0.60 mm.) |
| | Separation of the peristomes | 0.40 mm. |
| | Length of the peristomie | 0.20 mm. |

*Variations.*—This species is very well characterized by its rectilinear, salient tubes which give a *bristling* aspect to the zoarium. The zoarium, however, is rather variable, but it remains quite orbicular when the substratum is flat. We figure (fig. 3) a curious case of the influence of the substratum on the ovicell; in consequence of the zoarial envelopment about a thin bryozoan, the ovicell appears elongate by perspective and not transverse. It is not rare to encounter many zoaria side by side, but each is provided with a distinct ancestrula. Following observations already made, these zoaria do not grow over each other.

We have seen that in the Stomatoporoids the branches of the same zoarium never grow over each other; the same phenomenon occurs also in the *Berenicea* forms. In the latter the zoarial superpositions are produced by rejuvenescence. How can these animals, growing on the same substratum but proceeding from different larvae, recognize each other in order not to overlap? The life of these small beings is as mysterious as marvelous.

*Affinities.*—In its zoarial aspect and the bristling arrangement of the tubes, this species has given resemblance to *Berenicea verrucosa* Milne-Edwards, 1838; it differs from it in its smaller peristome (0.10 and not 0.16 mm.), its smaller zooecial distance (0.40 and not 0.70 mm.); besides, according to the figures given by Canu in 1898, the ovicell is much more elongated.[1]

This species is also close to *Plagioecia suborbicularis* Hincks, 1880, as it was figured by Canu in 1909, based upon specimens from the Lutetian; but the micrometric dimensions of the species are smaller than those of the American species.

It differs from *Microecia vibrio* in its rectilinear (and not serpentiform) zooecia; in its peristomial diameter of 0.10 mm. (and not 0.08 mm.), in its incrusting zoarium (and not unilamellar) and finally in its larger ovicell.

*Occurrence.*—Lower Jacksonian (Moodys marl): Jackson, Mississippi (common).

Middle Jacksonian: Wilmington, North Carolina (rare); near Lenuds Ferry, South Carolina (rare); Rich Hill, 5¼ miles southeast of Knoxville, Crawford County, Georgia (rare).

Upper Jacksonian (Ocala limestone): Red Bluff on Flint River, 7 miles above Bainbridge, Georgia (rare); Chipola River, east of Marianna, Jackson County, Florida (rare); Pachuta, Clarke County, Mississippi (very rare); Old Factory about 1½ miles above Bainbridge, Georgia (common).

Jacksonian (Zeuglodon bed): Bluff on south side of Suck Creek, Clarke County, Mississippi (rare).

Vicksburgian (Marianna limestone): Salt Mountain, 5 miles south of Jackson, Alabama (rare).

*Cotypes.*—Cat. Nos. 65305–65308, U.S.N.M.

### PLAGIOECIA MARGINATA, new species

Plate 125, figs. 1–8.

*Description.*—The zoarium is free, bilamellar, bushy, formed of undulated lobes branching in every direction. The tubes are distinct, elongated, flat, *bordered* by a salient thread, oval, arranged in irregular quincunx, striated transversally: the peristome is orbicular or elliptical frequently closed by a smooth calcareous lamella, thin and little salient. The ovicell is convex, little transverse, suborbicular. The zone of growth is hardly visible.

| *Measurements.*— | | |
|---|---|---|
| | Diameter of the peristome | 0.14 mm. |
| | Diameter of the zooecia | 0.20 mm. |
| | Distance between the peristomes | 0.70–0.90 mm. |

*Variations.*—The peristomie of the tubes was much longer than usually found in these species; a good specimen incrusted by a species of *Floridina* shows that it may be more than 1 millimeter in length. The unilamellar forms are not rare.

*Affinities.*—This species much resembles *Diastopora foliacea* Lamouroux, 1821, of the Bajocian and Bathonian of Europe, but differs from it in its smaller micrometric dimensions.

*Occurrence.*—Middle Jacksonian: Near Lenuds Ferry, South Carolina (common); Eutaw Springs, South Carolina (rare).

*Cotypes.*—Cat. No. 65461, U.S.N.M.

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[1] 1898. Canu, Etude sur les ovicelles des Bryozoaires du Bathonien d'Occaignes, Bulletin de la Société Geologique de France, ser. 3, vol. 26, p. 269.

### PLAGIOECIA DISCOIDEA, new species.

Plate 155, figs. 12–17.

*Description.*—The zoarium is free, orbicular, with the form of true *Discosparsa.* The tubes are distinct, cylindrical, smooth, bent upward at their extremity, arranged in regular quincunx; the peristome is elliptical, horizontal, thin. The zone of growth is hardly visible.

| *Measurements.*— | | |
|---|---|---|
| | Diameter of the peristome | 0.12 mm. |
| | Distance between the peristomes | 0.30 mm. |
| | Separation of the peristomes | 0.32 mm. |
| | Zoarial diameters | 4.00 mm. |

We have not found an ovicell well enough preserved to figure.

*Affinities.*—This species differs from the free forms of *Plagioecia concreta* in its zooecia regularly arranged in quincunx on the zoarial margins.

*Occurrence.*—Vicksburgian (Marianna limestone): One mile north of Monroeville, Alabama (common).

*Cotypes.*—Cat. No. 65461, U.S.N.M.

#### KEY TO DETERMINATION OF PLAGIOECIA AND BERENICEA.

Most of the species of *Berenicea* and *Diastopora* which we have examined probably belong, according to their exterior resemblances, to *Plagioecia.* We have therefore thought it necssary to combine them in the same key for determination. This will facilitate the identification of specimens coming from localities which have been studied. It is evident that such keys are purely artificial and that they can not serve as a basis for a natural classification. Moreover they are necessarily only approximations.

| | | |
|---|---|---|
| 1 | Zoarium bilamellar | 2. |
| | Zoarium unilamellar | 4. |
| | Zoarium incrusting | 8. |
| | Zoarium composite | 16. |
| 2 | Zoarium in thick, regular fronds | *Plagioecia subramosa.* |
| | Zoarium in thin lamellae | 3. |
| 3 | Tubes marginate | *Plagioecia marginata.* |
| | Tubes with large overlapping wrinkles | *Plagioecia lobata.* |
| | Tubes with thin widely spaced wrinkles | *Diastopora striatisemota.* |
| 4 | Zoarium discoidal (*Discosparsa*) | 5. |
| | Zoarium not discoidal (*Diastopora*) | 6. |
| 5 | Tubes in quincunx on the borders | *Plagioecia discoidea.* |
| | Tubes in radial rows on the borders | *Plagioecia concreta.* |
| 6 | Tubes marginate | *Plagioecia marginata.* |
| | Tubes not marginate | 7. |
| 7 | Peristome of 0.20–0.24 mm. | *Diastopora magnipora.* |
| | Peristome of 0.14–0.16 mm., zooecia indistinct | *Plagioecia tubifer.* |
| | Peristome of 0.14 mm., tubes distinct | *Plagioecia tuboedes.* |
| | Peristome of 0.12 mm., zoarium tubular | *Diastopora tubiformis.* |
| | Peristome of 0.12 mm., zoarium lamellar | *Plagioecia lamellosa.* |
| | Peristome of 0.10 mm. | *Diastopora striatisemota.* |
| 8 | The tubes are decorated with large overlapping wrinkles | *Berenicea undata.* |
| | The tubes are smooth or striated | 9. |
| 9 | The tubes are very close together nearly adjacent | 10. |
| | The tubes are widely spaced | 11. |
| 10 | Diameter of the peristome=0.14 mm | *Berenicea stipata.* |
| | Diameter of the peristome=0.10 mm | *Berenicea brevissima.* |

| | | |
|---|---|---|
| 11 | Peristome=0.18 mm., tubes horn-shaped | *Berenicea ingens.* |
| | Peristome=0.20 mm., tubes cylindrical | *Berenicea benjamini.* |
| | Peristome 0.16 mm. | *Berenicea incondita.* |
| | Peristome smaller | 12. |
| 12 | Zoarium palm-shaped, dichotomously branched and successive | *Berenicea palmula.* |
| | Zoarium orbicular or irregular | 13. |
| 13 | The zone of growth is very thick; the tubes are grouped in rows on the zoarial margins; P=0.10 mm. | *Plagioecia divagans.* |
| | Zone of growth little thick or invisible | 14. |
| 14 | Ovicell very long | *Plagioecia concreta.* |
| | Ovicell short | 15. |
| 15 | Peristome=0.12 mm., tubes claviform | *Plagioecia clavioedes.* |
| | Peristome=0.08–0.10 mm., tubes bent upward at the extremity | *Plagioecia brundidgensis.* |
| | Peristome=0.12–0.16 mm., tubes cylindrical | *Plagioecia botula.* |
| | Peristome=0.10 mm., tubes horn-shaped, rectilinear, not bent upward | *Plagioecia hirta.* |
| 16 | Separation of the peristomes=0.44 mm. | *Plagioecia superposita.* |
| | Separation of the peristomes=0.52 mm. | *Plagioecia concreta.* |

## DESMEPLAGIOECIA, new genus.

*Plagioecia* in which the tubes are grouped in fascicles.

*Genotype.—Berenicea lineata* MacGillivray, 1885.

*Range.*—Turonian-Recent.

This genus includes the genus *Actinopora* D'Orbigny, 1852, that is to say, the assemblage of species with orbicular zoarium. It is necessary to classify in it also certain species of *Reticulipora of the group Reticulipora obliqua* D'Orbigny, 1852. We include in it also some species of the old group of *Reptotubigera;* these are the incrusting dichotomous forms. We do not think that the zoarial dichotomization corresponds to a special function. In spite of the very great exterior difference between the zoarial forms *Actinopora* and *Reptotubigera*, we class in the same genus all the species in which the ovicell is identical and which are provided with fascicles. This ovicell is transverse and it interrupts or deforms the fascicles just as in *Plagioecia* it obstructs, separates, or deforms the isolated tubes. The ovicell is evidently formed before the calcification of the neighboring tubes.

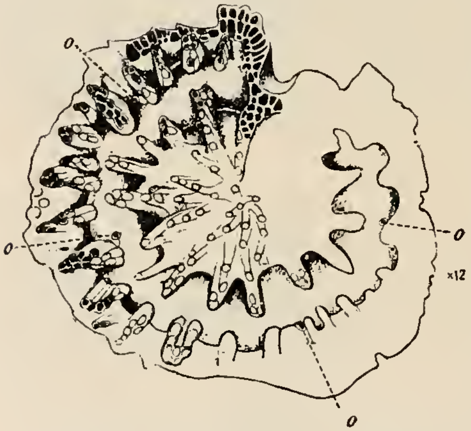


Fig. 234.—Desmeplagioecia, new genus. A colony of *Desmeplagioecia* (*Actinopora*) *lineata* MacGillivray, 1885, × 12, in which the ovicells form an almost complete ring. o, oeciostome. (After Harmer, 1915.)

The principal species hitherto described are;

*Desmeplagioecia* (*Berenicea*) *lineata* MacGillivray, 1885. Recent.

*Desmeplagioecia* (*Pavotubigera*) *gambierensis* Waters, 1884. Miocene.

*Desmeplagioecia* (*Pavotubigera*) *dimidiata* Waters, 1884 (not Reuss, 1847). Miocene.

*Desmeplagioecia* (*Semitubigera*) *dollfusi* Canu, 1909. Lutetian.

*Desmeplagioecia* (*Actinopora*) *organisans* D'Orbigny, 1851. Cretaceous.

### DESMEPLAGIOECIA DICHOTOMA, new species.

Plate 125, figs. 9–11.

*Description.*—The zoarium incrusts shells upon which it forms claviform, dichotomously branched lobes. The fascicles are crowded and arranged alternately on each side of the zooecial axis; they are formed of three to six zooecia. The tubes are short, distinct, little convex; the peristome is thin. The ovicell is convex, short, transverse; it interrupts five fascicles. The protoecium is very small in rapport with the ancestrula.

| | | |
|---|---|---|
| *Measurements.*— | Width of the fascicles | 0.12 mm. |
| | Separation of the fascicles | 0.16 mm. |
| | Width of the branches | 1.2–2.5 mm. |

*Occurrence.*—Upper Jacksonian (Ocala limestone): Old Factory about 1½ miles above Bainbridge, Georgia (rare).

*Cotypes.*—Cat. No. 65311, U.S.N.M.

### DESMEPLAGIOECIA COMPRESSA, new species.

Plate 125, figs. 16–19.

*Description.*—The zoarium has the *Reticulipora* form of growth with *compressed* fronds. The fascicles are incomplete, irregular, perpendicular to the zone of growth. The tubes are distinct, little convex. The peristome is orbicular, thin, salient. The zone of growth is very broad.

*Variations.*—According to fragments observed, the ovicell appears to be that of *Desmeplagioecia;* but this must be confirmed.

The fascicles are very irregular in length; they are often even replaced by cellular rows, in which the peristomes are not adjacent.

The *Reticulipora* form appears to develop chiefly in very calcareous waters.

*Occurrence.*—Upper Jacksonian (Ocala limestone): Chipola River, east of Marianna, Jackson County, Florida (rare).

*Cotypes.*—Cat. No. 65315, U.S.N.M.

### DESMEPLAGIOECIA LOBATA, new species.

Plate 126, figs. 4–7.

*Description.*—The zoarium is free, bilamellar, composed of lobes which are rounded, irregular, undulated, ramified. The fascicles are very short, formed of four or five tubes, scarcely salient, arranged on each side of the axis of folding or undulation of the lobes. The tubes are indistinct, isolated at the center and scattered on the margins. The zone of growth is thick and rather wide.

It is at hazard that we classify this species in the genus *Desmeplagioecia* as we possess only two nonovicelled specimens.

*Occurrence.*—Middle Jacksonian: Eutaw Springs, South Carolina (rare).

*Cotypes.*—Cat. No. 65317, U.S.N.M.

### DESMEPLAGIOECIA PLICATA, new species.

Plate 125, figs. 12–15.

*Description.*—The zoarium is bilamellar, formed of *folded*, irregular, undulated, flabellate or linear lobes. The fascicles are inconstant, irregular, little salient, long, perpendicular to the zoarial margins; the tubes are little distinct, isolated on the axis of undulation of flabelliform branches.

The zone of growth is wide and very fragile.

| | | |
|---|---|---|
| *Measurements.*— | Diameter of the peristome | 0.12–0.14 mm. |
| | Separation of the fascicles | 0.20 mm. |

*Variations.*—This species is quite remarkable, but unfortunately we know only a small number of specimens of which we have been unable to make a detailed study.

The species has the zoarial form of *Reticulipora*, but very irregular; the lobes are folded on themselves, but they are not elongated and linear. The flabelliform specimen is unilamellar.

*Occurrence.*—Middle Jacksonian: Wilmington, North Carolina (rare); near Lenuds Ferry, South Carolina (rare).

Upper Jacksonian (Ocala limestone): Nine miles north of Ocala, Florida (very rare); Alachua, Florida (very rare).

*Cotypes.*—Cat. Nos. 65313, 65314, U.S.N.M.

### DESMEPLAGIOECIA (ACTINOPORA) BREVIS, new species.

Plate 126, figs. 1–3.

*Description.*—The zoarium is orbicular and incrusts oysters. The fascicles are *short*, irregular, discontinuous, formed of three or four tubes, very salient, quite close together, arranged radially. The tubes are invisible; the peristome is thin, orbicular or quadrangular. The zone of growth is invisible, or much reduced.

| | | |
|---|---|---|
| *Measurements.*— | Diameter of the peristome | 0.12 mm. |
| | Distance between the fascicles | 0.09 mm. |
| | Diameter of the disks | 0.70 mm. |

*Affinities.*—This species differs from *Desmeplagioecia tenuissima* and *D. tenuis* Reuss, 1869, in its greater peristomial diameter (0.12 and not 0.08 mm.) and in the much smaller zone of growth.

*Occurrence.*—Upper Jacksonian (Ocala limestone): Red Bluff on Flint River, 7 miles above Bainbridge, Georgia (rare); Old Factory about 1½ miles above Bainbridge, Georgia (very rare).

*Cotypes.*—Cat. No. 65316, U.S.N.M.

### DESMEPLAGIOECIA (ACTINOPORA) TENUIS Reuss. 1869.

Plate 155, figs. 1–6.

1864. *Defrancia monosticha* Reuss, Ueber Anthozoen und Bryozoen der Mainzer Tertiärbeckens, Sitzungsberichte der k. Akademie der Wissenschaften, Wein, vol. 50, p. 11, pl. 3, fig. 1.
1869. *Discosparsa tenuis* Reuss, Paläontologische Studien über die alteren Tertiärschichten der Alpen, Crosaro, Denkschriften der k. Akademie der Wissenschaften, Wien, vol. 29, p. 280, pl. 34, figs. 9, 10.
1869. *Discosparsa regularis* Reuss, Idem, p. 280, pl. 34, fig. 11.
1887. *Discosparsa tenuis* Pergens, Note preliminaire sur les Bryozoaires fossiles de environs de Kolesvar, Bulletin de la Société royale Malacologique de Belgique, vol. 22, p. 37.
1892. *Diastopora tenuis* Waters, North Italian Bryozoa, Cyclostomata, Quarterly Journal of the Geological Society of London, vol. 47, p. 154.

*Description.*—The zoarium is free, discoidal, pedunculate or not. The fascicles are salient, very close together, arranged radially, almost continuous. The tubes are indistinct; the peristome is orbicular or quadrangular. The ovicell is very long, convex, parallel to the zoarial margin. The zone of growth is narrow. The lower face is concave, striated concentrically.

| | | |
|---|---|---|
| *Measurements.*— | Diameter of the peristome | 0.13 mm. |
| | Separation of the fascicles | 0.13 mm. |
| | Diameter of the zoaria | 3.00–6.00 mm. |

*Affinities.*—Our determination has been based on the figures and not upon German specimens. In aspect our figures are similar to those of *Defrancia monosticha* Reuss, 1864, but the American zoaria are larger. We see no difference from *Discosparsa tenuis* Reuss, 1869.

This species differs from *Desmeplagioecia brevis* in its fascicles, which are continuous and not interrupted, and in its free zoarium. It differs from *Desmeplagioecia tenuissima* in its larger zoarial diameter.

*Occurrence.*—Vicksburgian (Marianna limestone): One mile north of Monroeville, Alabama (common).

*Geological distribution.*—Priabonian of Vicentin (Reuss, Waters) and of Kolosvar (Pergens); Rupelian of Germany (Reuss).

*Plesiotypes.*—Cat. No. 65459, U.S.N.M.

### DESMEPLAGIOECIA (ACTINOPORA) TENUISSIMA, new species.

Plate 126, figs. 8–10.

*Description.*—The zoarium is discoidal, free or incrusting shells, eccentric. The fascicles are very *thin*, arranged radially, very salient, discontinuous. The tubes are invisible; the peristome is thin, orbicular, or rectangular. The ovicell is very long, thin, little convex. The zone of growth is thick and rather wide.

| | | |
|---|---|---|
| *Measurements.*— | Diameter of peristome | 0.08 mm. |
| | Separation of the fascicles | 0.12–0.15 mm. |
| | Diameter of the zoaria | 0.7 mm. |

This species is well characterized by its small peristomial diameter and its very little convex ovicell. *Desmeplagioecia brevis* and *Desmeplagioecia tenuis* Reuss, 1869, have a larger zooecial diameter (0.12 mm.).

*Occurrence.*—Upper Jacksonian (Ocala limestone): Chipola River, east of Marianna, Jackson County, Florida (rare); Red Bluff on Flint River, 7 miles above Bainbridge, Georgia (very rare); Old Factory, about 1½ miles above Bainbridge, Georgia (rare).

*Cotypes.*—Cat. Nos. 65318, 65319, U.S.N.M.

## Family MACROECIIDAE Canu, 1918.

1918. *Macroeciadae* Canu, Les ovicelles des bryozoaires cyclostomes, Bulletin Société Geologique de France, ser. 4, vol. 16, p. 328.

The longitudinal axis of the ovicell is parallel to the axis of the tubes. The ovicell is formed before the calcification of the neighboring tubes whose order and arrangement are disarranged. The oeciostome is immense and terminal.

This family is characterized by the size of its larva established by that of the oeciostome. No American species have so far been discovered.

### Genus MACROECIA Canu, 1918.

1918. *Macroecia* Canu, Les ovicelles des bryozoaires cyclostomes, Bulletin Société Geologique de France, ser. 4, vol. 16, p. 328.

The ovicell is elongate, elliptical, very salient. The oeciostome is not turned toward the bottom.

*Genotype.*—*Macroecia* (*Diastopora*) *lamellosa* Michelin, 1845. Jurassic.

## Family MECYNOECIIDAE Canu, 1918.

*Anatomical bibliography.*—1914, Waters, Bryozoa from Zanzibar, Proceedings of the Zoological Society of London, p. 840, pl. 2, figs. 1–49.—1918. Canu, Les ovicelles des bryozoaires cyclostomes, Bulletin de la Société Geologique de France, ser. 4, vol. 16, p. 326.

The ovicell is developed parallel to the tubes. It is formed before them and disarranges their respective position. The oeciostome is anterior and nonterminal.

The principal genera of this family are: *Mecynoecia* Canu, 1918, *Microecia* Canu, 1918, and *Exochoecia*, new genus.

### Genus MECYNOECIA Canu, 1918.

1918. *Mecynoecia* Canu, Les ovicelles des bryozoaires cyclostomes, Bulletin de la Société Géologique de France, ser. 4, vol. 16, p. 326.

The ovicell is symmetrical with indefinite contours. The oeciostome is elliptical, transverse, turned toward the base, generally supported by a tube.

*Genotype.*—*Mecynoecia* (*Entalophora*) *proboscidea* Milne-Edwards, 1838.

The principal known species of this genus are:

*Entalophora australis* Busk, 1875. Recent.
*Entalophora delicatula* Busk, 1875. Recent.
*Entalophora deflexa* Smitt, 1872. Recent.

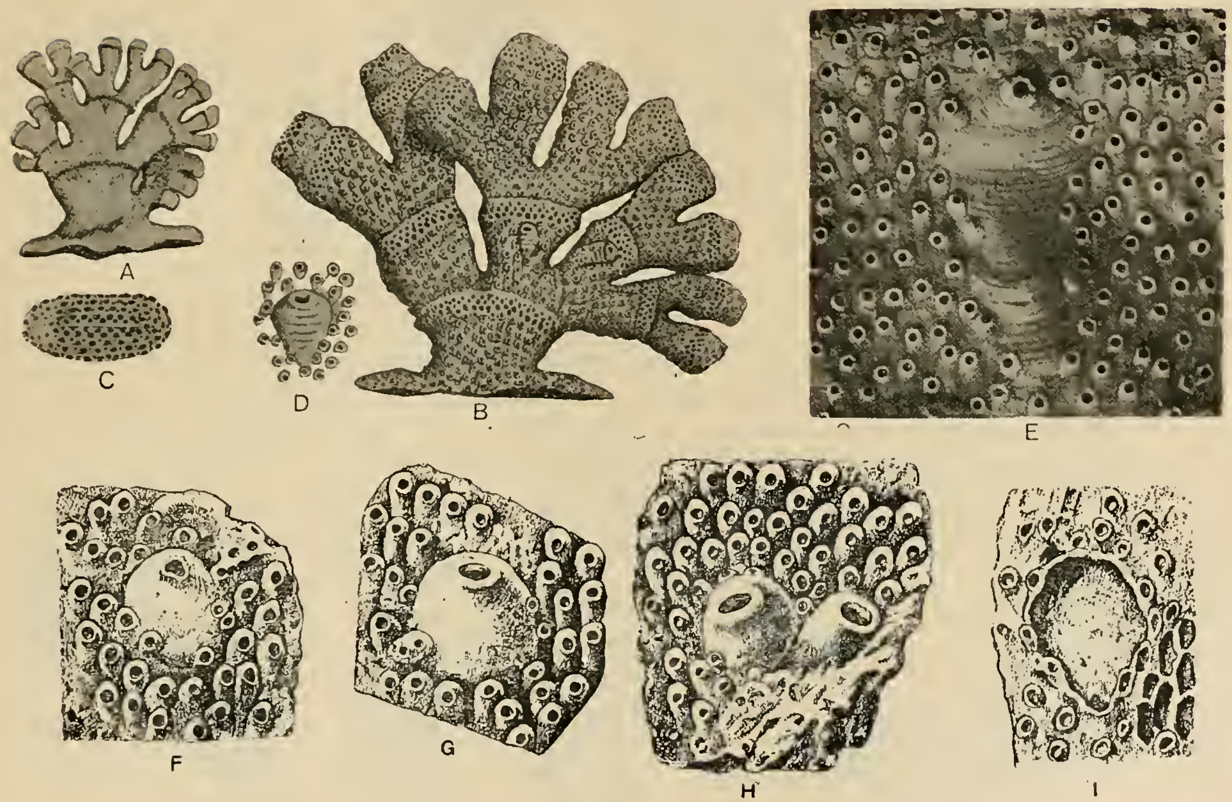
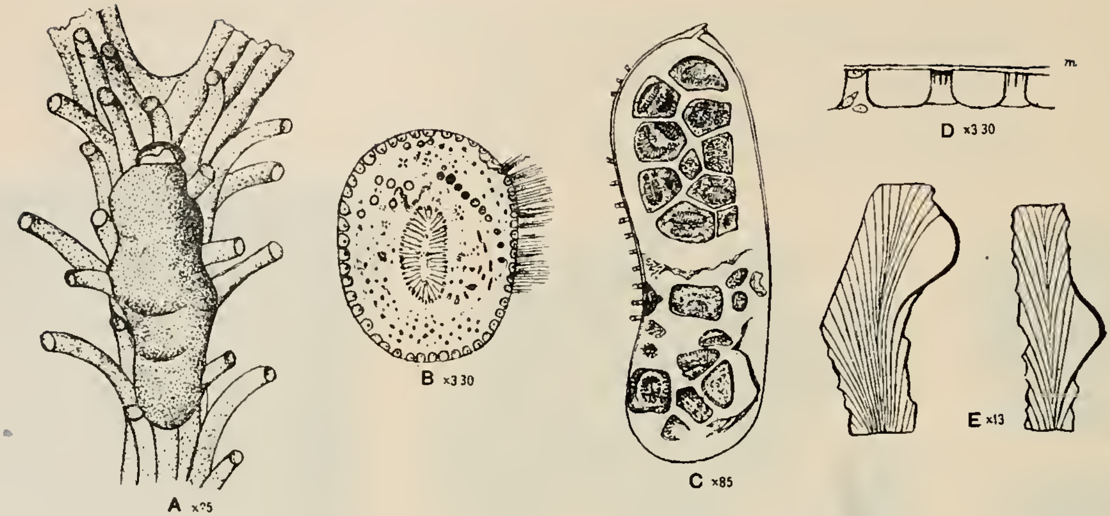


Fig. 235.—Genus *Macroccia* Canu; 1918.

A–I. *Macroccia* (*Diastopora*) *lamellosa* Michelin, 1845. A, B. Zoarium, natural size and enlarged. C. Cross section of branch, enlarged. D. Surface with ovicell, enlarged. (A–D. After D'Orbigny, 1854.) E. Another view, × 12, of an ovicelled specimen. F, G. Two views, × 18, showing the ovicell well developed. H. Example with two adjacent ovicells, × 18. I. A broken ovicell, × 18, showing the opening of the inferior tube of which it is only the dilated part. (F–I, after Canu.)

*Entalophora pulchella* Reuss, 1847. Priabonian.
*Entalophora madreporacea* Goldfuss, 1827. Cretaceous.
*Entalopora cretacea* D'Orbigny, 1850. Turonian-Senonian.
*Proboscina radiolitorum* D'Orbigny, 1851. Cenomanian.
*Entalophora cellarioides* Lamouroux, 1821. Jurassic.
*Proboscina angustata* D'Orbigny, 1851. Cretaceous.
*Laterotubigera flexuosa* D'Orbigny. Coniacian.



E. *Mecynoecia soror* Pocta, 1892. Longitudinal section through the ovicell, × 13.

A–D. *Mecynoecia delicatula* Busk, 1875. A. Fragment of zoarium, × 25, showing the elongated ovicell with transverse oeciostome. B. View of the embryo, × 270. C. Section of the ovicell containing embryos, × 85. D. Section of the surface pore tubes, × 330. The exterior membrane ($m$) is the ectocyst. (A–D after Waters, 1914.)

E. *Mecynoecia soror* Pocta, 1892. Longitudinal section through the ovicelli, × 13.

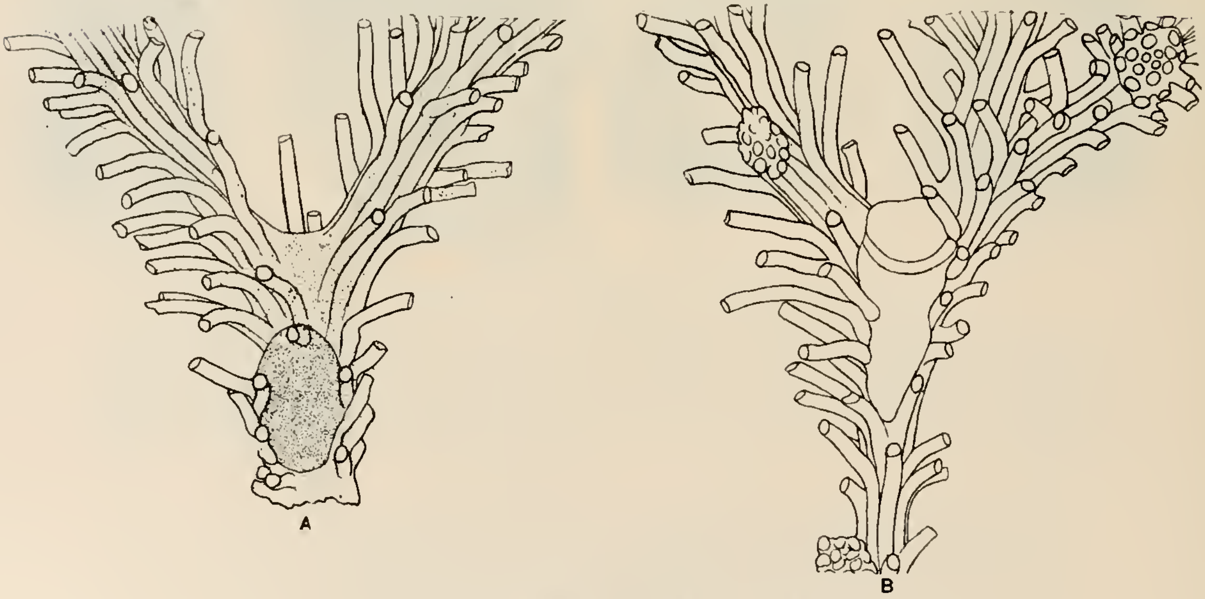


Fig. 237.—Genus *Mecynoecia* Canu, 1918.

A, B. Two ovicelled specimens of *Mecynoecia delicatula* Busk, 1875. (After Smitt, 1872.)

*Laterotubigera micropora* D'Orbigny, 1852. Coniacian.
*Entalophora vendinnensis* D'Orbigny, 1850. Cenomanian.
*Berenicea tenuis* D'Orbigny, 1850. Oxfordian.

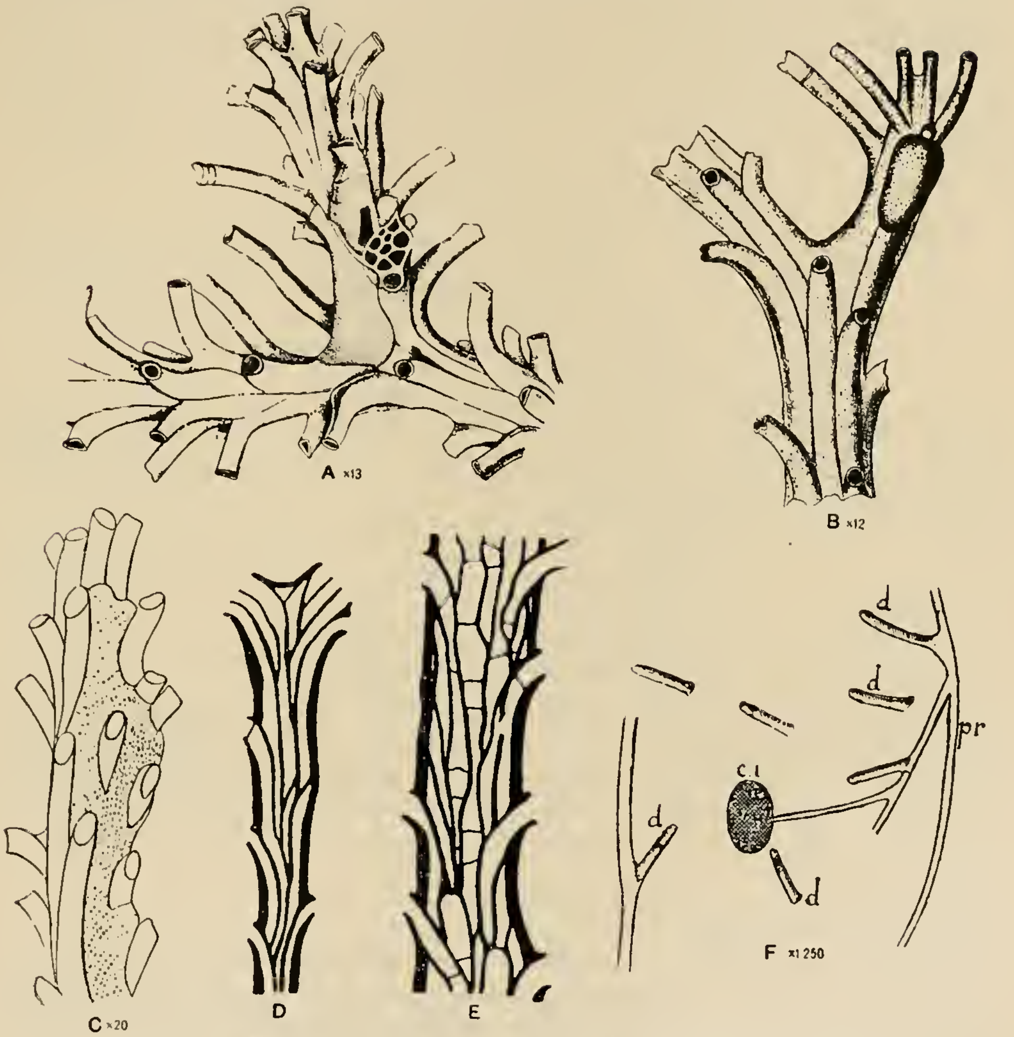


FIG. 238.—*Mecynoecia* (*Entalophora*) *proboscidea* Milne-Edwards, 1838.

A. Ovicelled branch enlarged. (After Harmer, 1915.) B. Another ovicelled specimen, × 12. (After Waters.) C. A third illustration of the ovicell, × 20. (After Neviani, 1905.) D. Longitudinal section of a slender colony. E. Longitudinal section of a thick, old branch of variety *rustica* Hagenow, 1850, with a central elongated cavity and with numerous septa. F. Longitudinal section of a part of the internal wall, × 1250. *c. i.*, interskeletal cavity; *d.*, denticles; *pr.*, prolongation. (D–F after Pergens, 1889.)

*Diastopora escharoides* Michelin, 1847. Cenomanian.
*Proboscina parvitubulata* Gregory, 1896. Bathonian.
*Diastopora davidsoni* Haime, 1854. Bajocian-Bathonian.

The known species of the zoarial form known as *Entalophora* are classified when the ovicell is known in the three genera *Diaperoecia*, *Mecynoecia*, and *Plagioecia*. Those which belong to *Plagioecia* have compact fronds of hollow zoaria, incrusting roots of algae, and in which the primitive berenicoid form is thus modified by the substratum. The species belonging to the genus *Diaperoecia* are relatively rare and have an aspect of regularity unknown in the other genus. The species belonging to the genus *Mecynoecia* are the most common. For the forms without ovicell we maintain as heretofore the zoarial genus *Entalophora*.

### MECYNOECIA PROBOSCIDEA Milne-Edwards, 1838.

Plate 108, figs. 1–15.

1900. *Entalophora proboscidea* NEVIANI, Briozoi neogenici delle Calabrie, Paleontographia italica, vol. 6, p. 242 (128) (regional bibliography).

1909. *Entalophora proboscidea* CANU, Bryozoaires des Terrains Tertiares des environs de Paris, Annales de Paleontologie, vol. 5, p. 118, pl. 15, figs. 11, 12. (illustrated paleontologic bibliography).

1915. *Entalophora proboscidea* CANU, Bryozoaires fossiles des terrains du Sud-Ouest de la France, Bulletin de la Société geologique de France, ser. 4, vol. 15, p. 331 (regional bibliography).

1915. *Entalophora proboscidea* HARMER, The Polyzoa of the *Siboga* expedition, p. 108, pl. 10, fig. 12 (recent bibliography).

| | | |
|---|---|---|
| *Measurements.*— | Diameter of the aperture | 0.16 mm. |
| | Diameter of the peristome | 0.16–0.20 mm. |
| | Width of the zooecia | 0.40 mm. |
| | Distance between the peristomes | 1.20–1.40 mm. |
| | Length of the peristomie | 0.30–0.40 mm. |

*Variations.*—This species is quite variable like all the common species, but its micrometric measurements are rather constant and it is very difficult to discover important varieties. The ovicell is not very constant in its form as may be noted from the published figures (fig. 225). Probably under the name of *Entalophora proboscidea*, there are many species of which it will be necessary to discover the constant characters.

*Occurrence.*—Midwayan (Clayton limestone): Mabelvale, near Little Rock, Arkansas (very common).

Middle Jacksonian: Wilmington, North Carolina (very common); near Lenuds Ferry, South Carolina (very common); 3¼ miles of Perry, Georgia (very common); Rich Hill, 5¼ miles southeast of Knoxville, Crawford County, Georgia (very common); one-half mile southeast of Georgia Kaolin Co. mine, Twiggs County Georgia (rare); 12 miles southeast of Marshallville, Georgia (very common); Baldock, Barnwell County, South Carolina (very rare); 18 miles west of Wrightsville, Johnson County, Georgia (rare); 3½ miles north of Grovania, Georgia (rare); 17 miles northeast of Hawkinsville, Georgia (very rare).

Upper Jacksonian (Ocala limestone): West bank Sepulga River, Escambia County, Alabama (common); Chipola River, east of Marianna, Jackson County, Florida (common); Old Factory, about 1½ miles above Bainbridge, Georgia (very rare).

Vicksburgian (Marianna limestone): Salt Mountain, 5 miles south of Jackson, Alabama (common); West bank Conecuh River, Escambia County, Alabama (very rare); One mile north of Monroeville, Alabama (very common); Murder Creek, east of Castlebury, Conecuh County, Alabama (very common).

*Geological distribution.*—Cretaceous-Recent. Cosmopolitan in Europe and America.

*Habitat.*—Cosmopolitan in both hemispheres and in the warm and temperate zones. This is a species of the depths; it appears first at 40 meters; attains its maximum of abundance toward 100 meters, and may descend almost to 330 meters. It affords, therefore, a very useful measure of depth.

*Plesiotypes.*—Cat. Nos. 65437, 65438, U.S.N.M.

### MECYNOECIA LUVERNENSIS, new species.

Plate 109, figs. 10–12.

*Description.*—The zoarium is an unbranched *Filisparsa* in which the noncelluliferous dorsal face is transversally wrinkled. The tubes are short, little visible, elevated at their extremity and terminated by a very short peristomie elevated almost vertically; the peristome is thick, orbicular. The ovicell is large, salient, globular; the oeciostome is elliptical, salient, transverse, supported on another tube.

| | | |
|---|---|---|
| *Measurements.*— | Diameter of the peristome | 0.20–0.22 mm. |
| | Diameter of the apertura | 0.16 mm. |
| | Diameter between the peristomes | 0.25 mm. |

*Occurrence.*—Midwayan (Clayton limestone): Luverne, Crenshaw County, Alabama (rare).

*Cotypes.*—Cat. No. 65257, U.S.N.M.

### MECYNOECIA CYLINDRICA, new species.

Plate 127, figs. 1–7.

*Description.*—The zoarium is an *Entalophora*, regularly *cylindrical*, bifurcated. The tubes are cylindrical, visible, separated by a very thin, salient thread; the peristomes are salient, orbicular, regularly arranged in quincunx. The ovicell is a large pyriform sack whose oeciostome is isolated.

| | | |
|---|---|---|
| *Measurements.*— | Diameter of the peristome | 0.10–0.12 mm. |
| | Distance between the peristomes | 0.42–0.46 mm. |
| | Separation of the peristomes | 0.36 mm. |
| | Diameter of the branches | 1.00 mm. |

*Affinities.*—This species is very well characterized by its pyriform ovicell, its cylindrical and regular branches, and by its zooecial margins. It is much smaller (peristome=0.10 and not 0.16 mm.) than *Mecynoecia lunata*, in which the branches are also quite cylindrical.

*Occurrence.*—Middle Jacksonian: Wilmington, North Carolina (very common); near Lenuds Ferry, South Carolina (rare); 18 miles west of Wrightsville, Johnson County, Georgia (very rare); 3½ miles north of Grovania, Georgia (rare).

*Cotypes.*—Cat. No. 65465, U.S.N.M.

### MECYNOECIA PUSILLA, new species

Plate 127, figs. 19–22.

*Description.*—The zoarium is a *small* bifurcated *Entalophora*. The tubes are distinct, cylindrical, convex; the peristomes are salient, thin, oblique, orbicular, arranged in irregular quincunx. The ovicell is elliptical, very long, striated transversally; the oeciostome is elliptical, large, salient.

| | | |
|---|---|---|
| *Measurements.*— | Diameter of the peristome | 0.10 mm. |
| | Distance between the peristomes | 0.50–0.70 mm. |
| | Diameter of the branches | 0.40 mm. |

This is a small species provided with very large ovicell. We might suppose that it was very prolific and coarse, but this is not so, as it is very delicate and its life was ephemeral. This is within the domain of the pathologist who must search for the causes of these unexpected occurrences. It is the smallest species of the genus.

*Occurrence.*—Middle Jacksonian: Near Lenuds Ferry, South Carolina (very rare); 3½ miles north of Grovania, Georgia (very rare).

Upper Jacksonian (Ocala limestone): Chipola River, east of Marianna, Jackson County, Florida.

*Cotypes.*—Cat. Nos. 65470, 65471, 65484, U.S.N.M.

### MECYNOECIA BREVIS, new species.

Plate 127, figs. 8–18.

*Description.*—The zoarium is an *Entalophora* with branches claviform, compressed, and bifurcated. The tubes are cylindrical, distinct, little convex, terminated at their extremity by a long peristomie upward bent; the peristomes are orbibular, thick, and arranged in irregular quincunx. The ovicell is large, *short*, very finely porous; the oeciostome is elliptical, transverse, attached to the peristome of a tube. The zone of growth is very short and rounded.

| | | |
|---|---|---|
| *Measurements.*— | Diameter of the peristome | 0.16 mm. |
| | Diameter of the orifice | 0.10 mm. |
| | Diameter of the tubes | 0.20 mm. |
| | Distance between the peristomes | 0.40–0.60 mm. |
| | Maximum length of the peristomie | 0.40 mm. |

*Variations.*—The zoarium is formed of claviform branches sometimes terminated by irregular ramifications; cylindrical branches are rare. The length of the peristomie depends upon how well the fossils are preserved. The quincunx arrangement of the peristomes is not very regular and we figure a specimen where they are arranged in transversal rows.

*Affinities.*—This species differs from *Mecynoecia compressa* in its much shorter ovicell, its zoarium less lamellar, and its shorter distance between the peristomes. It differs from *Entalophora subcompressa* Reuss, 1866, of which it is the American representative, in the length of its peristomie.

*Occurrence.*—Middle Jacksonian: Eighteen miles west of Wrightsville, Georgia (very rare); Eutaw Springs, South Carolina (very rare); Georgia Kaolin Company's mine, Twiggs County, Georgia (very rare); Rich Hill, five and one-fourth miles south of Knoxville, Crawford County, Georgia (rare).

Jacksonian (Zeuglodon zone); Shubuta, Mississippi (very rare) south side of Suck Creek, Clarke County, Mississippi (very rare).

*Cotypes.*—Cat. Nos. 65466–65469 U.S.N.M.

### MECYNOECIA MAGNICELLA, new species.

Plate 128, figs. 1, 2.

*Description.*—The zoarium is an *Entalophora* with cylindrical branches. The tubes are cylindrical, distinct, disposed in irregular quincunx, striated transversally, *very large;* bent upward at their extremity and terminated by an oblique, little salient peristomie; the peristome is thick, orbicular, oblique.

| | | |
|---|---|---|
| *Measurements.*— | Diameter of the peristome | 0.24 mm. |
| | Diameter of the apertura | 0.18 mm. |
| | Diameter of the zooecia | 0.30–0.36 mm. |
| | Distance between the peristomes | 1.40 mm. |
| | Separation of the peristomes | 1.40 mm. |
| | Maximum length of the peristomie | 0.30 mm. |
| | Diameter of the zoarium | 1.25 mm. |

This species is the largest of the American fossils described in the present memoir. Its determination is therefore very easy. The ovicell is unknown. Only the figured specimen has been collected.

*Occurrence.*—Upper Jacksonian (Ocala limestone): Alachua, Florida (very rare).

### MECYNOECIA COMPRESSA, new species.

Plate 155, figs. 18–22.

*Description.*—The zoarium is formed of lamellar, cylindrical or slightly *compressed* fronds. The tubes are distinct, convex, striated transversally; the peristomes are little salient, thin, orbicular or elliptical, arranged in very irregular quincunx. The ovicell is elliptical, very elongate, subsymmetrical; the oeciostome is transverse and placed on the peristomie of a tube.

| | | |
|---|---|---|
| *Measurements.*— | Diameter of the peristome | 0.16 mm. |
| | Distance between the peristomes | 0.60 mm. |
| | Separation of the peristomes | 0.52 mm. |

*Variations.*—The quincunx arrangement of the peristomes is very irregular and it is not rare to find them adjacent to each other. The oeciostome appears to open into the peristomie of the tube to which it is attached, but this is only an illusion, for by scraping it with a scalpel we were able to verify that it really opens into the ovicell.

*Affinities.*—This species is easy to determine on account of its much compressed branches. It differs from *Mecynoecia brevis*, in which this character appears, in the absence of the long peristomies and in its much elongate ovicell.

*Occurrence.*—Vicksburgian (Marianna limestone): One mile north of Monroeville, Alabama (rare).

*Cotypes.*—Cat. No. 65462, U.S.N.M.

### MECYNOECIA QUISENBERRYAE, new species.

Plate 156, figs. 26–30.

*Description.*—The zoarium is an *Entalophora* with cylindical and bifurcated branches. The tubes are little visible, garnished with transverse, overlapping wrinkles, arranged in quincunx or in oblique verticells; the peristome is thick, orbicular, little salient. The ovicell is very elongate, symmetrical, smooth; the oeciostome is supported on the tube and has the form of a lunar crescent.

| | | |
|---|---|---|
| *Measurements.*— | Diameter of the peristome | 0.18–0.20 mm. |
| | Distance between the peristomes | 0.50–0.60 mm. |
| | Separation of the peristomes | 0.50–0.60 mm. |
| | Diameter of the branches | 1.00 mm. |

*Affinities.*—This species is very close to *Mecynoecia lunata* in the general arrangement of the tubes. It differs from it in its larger peristome (more than 0.16 mm.) and in its tubes which are closer together.

We dedicate this species to Miss Adelaide C. Quisenberry, of the United States National Museum, in appreciation of her help and interest in the preparation of this work.

*Occurrence.*—Vicksburgian (Marianna limestone): Salt Mountain, 5 miles south of Jackson, Alabama (common).

*Cotypes.*—Cat. No. 65396, U.S.N.M.

### MECYNOECIA LUNATA, new species.

Plate 156, figs. 1–8.

*Description.*—The zoarium is an *Entalophora*, regularly cylindrical and bifurcated. The tubes are distinct, cylindrical, separated by a little salient thread; the peristomes are thick, orbicular, arranged in quincunx or in Peripora. The ovicell is very elongate, very finely punctate; the oeciostome is very large, transverse, attached to a tube and has the form of a *lunar crescent*.

| | | |
|---|---|---|
| *Measurements.*— | Diameter of the peristome | 0.14–0.16 mm. |
| | Diameter of the apertura | 0.08 mm. |
| | Distance between the peristomes | 0.70 mm. |
| | Separation of the peristomes | 0.50 mm. |
| | Diameter of the branches | 1.00 mm. |

*Variations.*—The young zooecia are convex and are not bordered by a salient thread. The peristomie is not constant and is never very salient. The peristomes are often grouped in oblique verticells, an arrangement which characterizes the form *Peripora* of D'Orbigny.

*Affinities.*—This species differs from *Mecynoecia cylindrica* in its larger peristome (0.16 and not 0.10 mm.). It differs from *Mecynoecia quisenberryae* in the absence of overlapping wrinkles and in its smaller peristome (0.16 and not 0.20 mm.), and from *Mecynoecia semota* in the lesser distance between the peristomes. in the less salient peristomies, and in its never claviform zoarium.

The immense occiostome characterizes this species very well.

*Occurrence.*—Vicksburgian (Marianna limestone): West bank Conecuh River, Escambia County, Alabama (very common); near Claiborne, Monroe County, Alabama (common); Murder Creek, east of Castlebury, Conecuh County, Alabama (very common).

*Cotypes.*—Cat. No. 65391–65393, U.S.N.M.

### MECYNOECIA SEMOTA, new species.

Plate 156, figs. 9–25.

*Description.*—The zoarium is a cylindrical or claviform *Entalophora* never containing more than eight longitudinal rows of zooecia. The tubes are horn-shaped, narrowed at the back, enlarged in the vicinity of the peristome, distinct, convex, striated transversally, bent upward at their extremity and terminated by a free peristomie; very oblique and salient; their peristomes are *widely separated* from each other, orbicular or elliptical. The ovicell is an elongate and symmetrical sack.

| | | |
|---|---|---|
| *Measurements.*— | Diameter of the salient peristome | 0.12 mm. |
| | Diameter at the base of the peristomie | 0.16 mm. |
| | Distance between the peristomes | 0.90 mm. |
| | Separation of the peristomes | 0.60 mm. |
| | Length of the peristomie | 0.34 mm. |
| | Diameter of the zoarium | 1.00 mm. |

*Variations.*—The micrometric dimensions of this species are quite variable and one should not attempt to determine isolated specimens. Our measurements (except the first) are only the most frequent averages. On certain specimens the distance is only 0.50 mm. and abruptly on others it attains 1.00 mm.; in the latter case its distinction from *Mecynoecia elongatotuba* is very slight. The separation of the peristomes is a little less variable; it varies, however, between 0.50 and 0.60 mm.

The zoarium is never exactly cylindrical and claviform fronds are not rare. The zoarial base is a little hook and not a calcareous basal expansion.

*Affinities.*—This species differs from *Mecynoecia lunata* in its thinner branches with 8 rows of tubes instead of 12, and in its smaller peristome (0.12 and not 0.16 mm.). It differs from *Mecynoecia elongatotuba* in 8 rows of tubes instead of 6, and in its generally much smaller distance between the peristomes (0.90 and not 1.20 mm.), and from *Entalophora pulchella* Reuss, 1847, in its longer peristomie.

*Occurrence.*—Vicksburgian (Marianna limestone): West bank of Conecuh River, Escambia County, Alabama (very common): Salt Mountain, 5 miles south of Jackson, Alabama (rare); Murder Creek, east of Castlebury, Conecuh County, Alabama (rare); deep well, Escambia County, Alabama (rare); 1 mile north of Monroeville, Alabama (very common).

Vicksburgian (Red Bluff clay): One-fourth of a mile of Woodwards, Wayne County, Mississippi (rare).

*Cotypes.*—Cat. Nos. 15394, 65395, U.S.N.M.

### MECYNOECIA ELONGATOTUBA, new species.

Plate 155, figs. 23–29.

*Description.*—The zoarium is a cylindrical and bifurcated *Entalophora* with six longitudinal rows of zooecia. The tubes are distinct, convex, *very long*, striated transversally, bent upward at their extremity and terminated by a short very oblique peristomie; the peristome is thin, orbicular, oblique.

| | | |
|---|---|---|
| *Measurements.*— | Diameter of peristome | 0.12 mm. |
| | Distance between the peristomes | 0.90–1.20 mm. |
| | Separation of the peristomes | 0.44–0.50 mm. |
| | Diameter of the branches | 0.90 mm. |

*Variations.*—The length of the tubes is very characteristic but it is not constant; on certain branches it is only 0.80 mm.; it is never more than 1.20 mm. The branches are never exactly cylindrical; their base is often narrowed.

The ovicell and the base are unknown.

*Affinities.*—This species differs from *Mecynoecia semota*, of which the diameter of the peristome is identical in its thinner branches with six rows of zooecia instead of eight and in the long distance between the peristomes—almost always greater than 0.90 mm.

It differs from *Mecynoecia parvituba*, of which it has a little the general aspect, in its larger peristomial diameter (0.12 and never 0.10 mm.).

*Occurrence.*—Vicksburgian (Red Bluff clay): Seven and one-half miles southwest of Bladen Springs, Alabama (common).

Vicksburgian (Marianna limestone): Murder Creek, east of Castlebury, Conecuh County, Alabama (very rare).

*Cotypes.*—Cat. No. 65463, U.S.N.M.

### MECYNOECIA CORNUTA, new species.

Plate 155, figs. 30–36.

*Description.*—The zoarium is a cylindrical and bifurcated *Entalophora*. The tubes are little distinct, convex, widened at their extremity, *horn-shaped*, little narrowed at the base, slightly striated transversally; the peristome is thin, elliptical, very little salient. The ovicell is quite elongate, smooth, globular, salient; the oeciostome is elliptical transverse, supported on a peristome.

| | | |
|---|---|---|
| *Measurements.*— | Diameter of the peristome | 0.14 mm. |
| | Distance between the peristomes | 0.60 mm. |
| | Separation of the peristomes | 0.50–0.52 mm. |
| | Diameter of the branches | 0.66 mm. |

*Affinities.*—This species differs from *Mecynoecia semota*, in which the tubes are also horn-shaped, in its peristome of 0.14 and not 0.12 mm., and in its lesser peristomial distance (0.60 and not 0.90 mm.).

It differs from *Mecynoecia lunata* in which the separation of the peristomes is very similar in the thinner branches, never containing more than eight longitudinal rows of zooecia, and in the absence of a salient thread between the tubes.

*Occurrence.*—Vicksburgian (Marianna limestone): One mile north of Monroeville, North Carolina (common); deep well, Escambia County, Alabama (very rare).

*Cotypes.*—Cat. No. 65464, U.S.N.M.

### MECYNOECIA PARVITUBA, new species.

Plate 128, figs. 3–7.

*Description.*—The zoarium is a thin *Entalophora*, with six longitudinal rows of zooecia. The tubes are *small*, little distinct, slightly striated transversally, bent upward at their extremity, and terminated by a salient peristomie; the peristome is thin, orbicular, oblique.

| | | |
|---|---|---|
| *Measurements.*— | Diameter of the peristome | 0.10 mm. |
| | Distance of the peristomes | 0.60–1.00 mm. |
| | Separation of the peristomes | 0.40–0.60 mm. |
| | Diameter of the branches | 0.50 mm. |

*Affinities.*—This small species is quite well characterized by its small peristomial dimensions. It differs from *Mecynoecia pusilla* in which the diameter is identical in its zooecial length, much more than 0.70 mm. It differs from *Mecynoecia elongatotuba* in its still thinner branches and in its peristomial diameter of 0.10 mm. (never 0.12 mm.).

*Occurrence.*—Vicksburgian (Marianna limestone): One mile north of Monroeville, Alabama (common).

Upper Jacksonian (Ocala limestone): Old Factory, about 1½ miles above Bainbridge, Georgia (very rare).

*Cotypes.*—Cat. No. 65321, U.S.N.M.

### MECYNOECIA LOBATA, new species.

Plate 157, figs. 1, 2.

*Description.*—The zoarium is a *Proboscina*, creeping on shells; it is formed of pluricellular branches, bifurcated, and irregularly *lobed.* The tubes are indistinct and very short; the peristomes are thin, very near one another and arranged in quincunx. The ovicell is small, little salient, little elongate; the ooeciostome is as large as a tube, transverse, placed on the peristomie of a tube.

| | | |
|---|---|---|
| *Measurements.*— | Distance between the peristomes | 0.14–0.16 mm. |
| | Separation of the peristomes | 0.40 mm. |

*Occurrence.*—Vicksburgian (Marianna limestone): Near Claiborne, Monroe County, Alabama (rare).

*Holotype.*—Cat. No. 65397 U.S.N.M.

### MECYNOECIA GLOBULA, new species.

Plate 157, figs. 3, 4.

*Description.*—The zoarium incrusts bryozoa; it is a *Proboscina* with club-shaped branches. The tubes are short, little distinct, somewhat striated transversally, bent upward at their extremity and terminated by a short peristomie elevated vertically; the peristome is thin and orbicular. The ovicell is little elongate, *globular*, smooth, symmetrical; the ooeciostome is elliptical, transverse, as wide as the tube by which it is supported.

| | | |
|---|---|---|
| *Measurements.*— | Diameter of the peristome | 0.10 mm. |
| | Distance between the peristomes | 0.40 mm. |
| | Separation of the peristomes | 0.46–0.50 mm. |

*Occurrence.*—Vicksburgian (Marianna limestone): One mile north of Monroeville, Alabama (rare).

*Cotypes.*—Cat. No. 65398, U.S.N.M.

## Forma ENTALOPHORA Lamouroux, 1821.

We introduce in this zoarial genus or forma the species with the tubes opening on all sides of the cylindrical branches, but in which no ovicells have been discovered. Most of the species hitherto referred to *Entalophora*, have the elongated ovicell of *Mecynoecia.*

### ENTALOPHORA STIPATA, new species.

Plate 108, fig. 16.

*Description.*—The zoarium is cylindrical, club-shaped; the tubes are indistinct, arranged in regular quincunx and transversal verticells; the peristomes are *quite close*, thin, little salient, orbicular.

| | | |
|---|---|---|
| *Measurements.*— | Diameter of the peristome | 0.12 mm. |
| | Distance between the peristomes | 0.30–0.36 mm. |
| | Diameter of the branches | 1.00 mm. |

The figured specimen only has been found, but it is quite characteristic.

*Occurrence.*—Midwayan (Clayton limestone): Mabelvale, near Little Rock, Arkansas (very rare).

*Holotype.*—Cat. No. 65439, U.S.N.M.

### ENTALOPHORA CRASSA, new species.

Plate 113, figs. 1–5.

*Description.*—The zoarium is free, cylindrical, *very large.* The tubes are cylindrical, very little distinct, often wrinkled transversally; the peristomes are thick, very salient, orbicular, close to one another, sometimes adjacent two by two.

| | | |
|---|---|---|
| *Measurements.*— | Diameter of the peristome | 0.14 mm. |
| | Diameter of the apertura | 0.06–0.08 mm. |
| | Distance between the peristomes | 0.40–0.54 mm. |
| | Separation of the peristomes | 0.46–0.70 mm. |
| | Diameter of the branches | 3.00 mm. |

*Variations.*—In longitudinal section the tubes are very long, rarely branched. In transversal section they are polygonal.

*Occurrence.*—Claibornian (Gosport sand): One mile southwest of Rockville, Clarke County, Alabama (rare).

*Holotype.*—Cat. No. 65431, U.S.N.M.

## Genus MICROECIA Canu, 1918.

1918. *Microecia* Canu, Les ovicelles des Bryozoaires cyclostomes, Bulletin Société Geologique France, ser. 4, vol. 16, p. 325.

The ovicell is very small and is spread between only four tubes; the oeciostome is small and hardly salient.

*Genotype.*—*Berenicea sarniensis* Norman, 1864.

*Range.*—Senonian-Recent.

The previously known species belonging to this genus are:

*Berenicea sarniensis* Norman, 1864. Recent.

*Diastopora tubulus* D'Orbigny, 1851. Senonian.

*Berenicea suborbicularis* Hincks, 1880. Recent.

In the absence of the oeciostome the differentiation of this genus from *Oncousoecia* is very difficult.

### MICROECIA FLABELLATA, new species.

Plate 128, figs. 19, 20.

*Description.*—The zoarium incrusts shells and bryozoa; it is *flabellate*, eccentric. The tubes are little distinct, flat, smooth, horn-shaped, very narrow proximally, grouped on the zoarial margins in false radial rows; the peristome is elliptical, thin, sharp. The ovicell is small, globular, salient; the oeciostome is isolated and hardly salient. The zone of growth is thick but little wide.

| | | |
|---|---|---|
| *Measurements.*— | Diameter of the peristome | 0.14 mm. |
| | Distance between the peristomes | 0.60–0.70 mm. |

Some zooecia are closed by a calcareous septum. We know that the latter is always placed at the base of the peristomie. Most certainly this species was provided with tubes with long peristomies, as the elliptical form of the apertura proves.

*Affinities.*—This species differs from *Berenicea regularis* D'Orbigny, 1852, of the Cenomanian, and from *Diastopora suborbicularis* (Hincks, 1880), Canu, 1909, of the Lutetian in its wider peristome (0.14 and not 0.06–0.10 mm.), and in the arrangement of its peristomes in false radial series.

*Occurrence.*—Middle Jacksonian (Castle Hayne limestone): Wilmington, North Carolina (rare).

*Holotype.*—Cat. No. 65324, U.S.N.M.

### MICROECIA VIBRIO, new species.

Plate 128, figs. 14–18.

*Description.*—The zoarium creeps on algae or more often on Orbitoid foraminifera and shells; it is orbicular or elliptical, almost always eccentric. The tubes are indistinct at the center, distinct and *serpentiform* on the zoarial margins; arranged in quincunx; the peristome is elliptical or triangular, thin, salient, or placed at the extremity of a short peristomie. The ovicell is globular and small. The zone of growth is very little visible.

| | | |
|---|---|---|
| *Measurements.*— | Diameter of the peristome | 0.08–0.10 mm. |
| | Distance of the peristomes | 0.30–0.40 mm. |
| | Separation of the peristomes | 0.26 mm. |

The central part of the large zoaria and the young zoaria do not have distinct tubes; they are only visible in their peristomie more or less salient and elevated. The serpentiform tubes are only visible on the completely developed zoaria; often even the separating furrow disappears in fossilization. The presence of closed zooecia indicates a more salient peristomie than that persisting on the fossils.

*Affinities.*—This species differs from *Microecia hirta* in the somewhat larger diameter of the peristome (often more than 0.08 mm.) and in the form of its zooecia.

*Occurrence.*—Upper Jacksonian (Ocala limestone): Chipola River, east of Marianna, Jackson County, Florida (rare); below Plant System railroad wharf, Bainbridge, Georgia (rare).

Vicksburgian (Marianna limestone): Salt Mountain, 5 miles south of Jackson, Alabama.

*Cotypes.*—Cat. Nos. 65323, 65486, U.S.N.M.

### MICROECIA HIRTA, new species.

Plate 157, figs. 5–8.

*Description.*—The zoarium is free, unilamellar, suborbicular. The tubes are hardly distinct, bent up at their extremity and terminated by a long, very oblique peristomie; the peristome is thin, elliptical. The ovicell is small, globular, little salient; the oeciostome is not salient. It has no zone of growth.

*Measurements.*—

| | |
|---|---|
| Diameter of the peristome | 0.08–0.10 mm. |
| Distance of the peristomes | 0.40 mm. |
| Separation of the peristomes | 0.30 mm. |
| Length of the peristomie | 0.10–0.16 mm. |

*Affinities.*—The zoarium appears as a disk garnished with *points;* but we have not had the fortune to collect a single complete disk, for it seems extremely fragile.

This species differs from *Microccia vibrio* in its free, orbicular zoarium and in its rectilinear, never serpentiform, zooecia. It differs from *Plagioecia lamellosa* not only in the nature of the ovicell, but also in its smaller peristome (0.08 and not 0.12 mm.) and in its other dimensions, which are always smaller. The zoaria are absolutely identical.

*Occurrence.*—Vicksburgian (Marianna limestone): West bank Conecuh River, Escambia County, Alabama (rare).

*Cotypes.*—Cat. No. 65399, U.S.N.M.

## EXOCHOECIA, new genus.

Greek: *Exoche*, prominence; in allusion to the position of the ovicell.

The ovicell is large, symmetrical; it is placed on the zone of growth which it grows beyond, forming a large exterior saliency; the oeciostome is small, anterior, elliptical, turned toward the base.

*Genotype.*—*Exochoecia rugosa*, new species. Vicksburgian.

### EXOCHOECIA RUGOSA, new species.

Plate 158, figs. 1–16.

*Description.*—The zoarium is a reticulate *Mesenteripora;* it is formed of irregular lamellae, presenting a rounded fold opposite the zone of growth. The tubes are arranged in quincunx in the vicinity of the fold and in radial rows perpendicular to the zone of growth on the rest of the zoarium; they are indistinct and ornamented with large overlapping *wrinkles.* The peristomes are orbicular or elliptical, almost adjacent in the lines. The ovicell is large, pyriform, suspended on the zoarial margins, ornamented with large, transverse, widely spaced wrinkles; the oeciostome is small, elliptical, transverse, turned toward the base.

*Measurements.*—

| | |
|---|---|
| Diameter of the peristomes | 0.10 mm. |
| Separation of the lines | 0.24 mm. |

*Variations.*—We know that these reticulate zoaria result from the folding of a primitive berenicoid zoarium and from the bending back of the folded fronds at the top. One of the consequences of this bending back is that the axis of the peristomes no longer coincides with the axis of the median tubes which develop on the basal lamella and which appear at the zone of growth. The tubes opening laterally on the fronds are from preceding ramifications; the axis of the peristome is indeed that of their zooecium, but the lines of the peristome are oriented perpendicularly to the zoarial margins and their traces are indicated in thin sections by their peculiar undulations (fig. 16) regularly spaced. The reader will better comprehend this peculiar arrangement by consulting figure 12 which shows the interior of the tubes obtained by the ablation of one of the two lamellae of the zoarium.

The oeciostome is smaller than a tube as in the genus *Microecia*, but it is turned toward the base; it is isolated and is never supported on the peristome of a tube.

In spite of the large transverse wrinkles which ornament the tubes, the tangential section indicates that their walls are absolutely identical with those of all the other Cyclostomata (fig. 11).

When the transverse section is indeed perpendicular at the time of the folding and at the zone of growth (fig. 14), the tubes adjacent to the basal lamella are alone visible. In the other case the tubes appear formed on the basal lamella and above their ramifications form the peristomial lines (fig. 16).

*Affinities.*—This species differs from *Reticulipora nummulitorum* D'Orbigny, 1852, and from *Reticulipora plicata* Canu, 1909, of the French Lutetian, in its different micrometric measurements and in its larger wrinkles. Moreover, the ovicells of the two latter species are not known.

This species is quite characteristic of the Vicksburgian.

*Occurrence.*—Vicksburgian (Red Bluff clay): Seven and one-half miles southwest of Bladen Springs, Alabama (rare); one-fourth mile west of Woodward, Wayne county, Mississippi.

Vicksburgian (Marianna limestone): Murder Creek, east of Castlebury, Conecuh County, Alabama (common); west bank Conecuh River, Escambia County, Alabama (common); Salt Mountain, 5 miles south of Jackson, Alabama (very rare); near Claiborne, Monroe County, Alabama (common); one mile north of Monroeville, Alabama (very common).

*Cotypes.*—Cat. No. 65405, U.S.N.M.

## Family DIAPEROECIIDAE Canu, 1918.

*Anatomical bibliography.*—1887. Waters, On tertiary Cyclostomatous Bryozoa, Quarterly Journal of the Geological Society, vol. 43, pl. 18, figs. 5, 6, 13, 14, 15.—1903. Waters, Bryozoa from Franz Josef Land, Journal Linnean Society, London, vol. 28, p. 173, pl. 19, figs. 1–13.—1905. Waters, Bryozoa from near Cape Horn, Journal Linnean Society, London, vol. 29, p. 247, pl. 29, figs. 10–14.—1914. Waters, The Marine Fauna of British East Africa and Zanzibar, Proceedings of the Zoological Society of London, p. 836.

The ovicell is formed after the calcification of the distal tubes. It is an irregular, subglobular elevation, placed among many tubes which project on the ovicell itself. The oeciostome is submedian, transverse, salient, often isolated, generally proximally directed.

We do not know the larva, but this family appears different from the Tubuliporidae in its oeciostome which is often isolated and in its expansion by which it completely surrounds the tubes or the fascicles.

When the ovicell is very thick the tubes appear displaced and more scattered. This is only an illusion provoked by the elongation of the tubes and their divergence; at their base they have the normal distance. (See *Diaperoecia clava.*)

The tubes which traverse the ovicell are often closed by a finely porous, calcareous lamella.

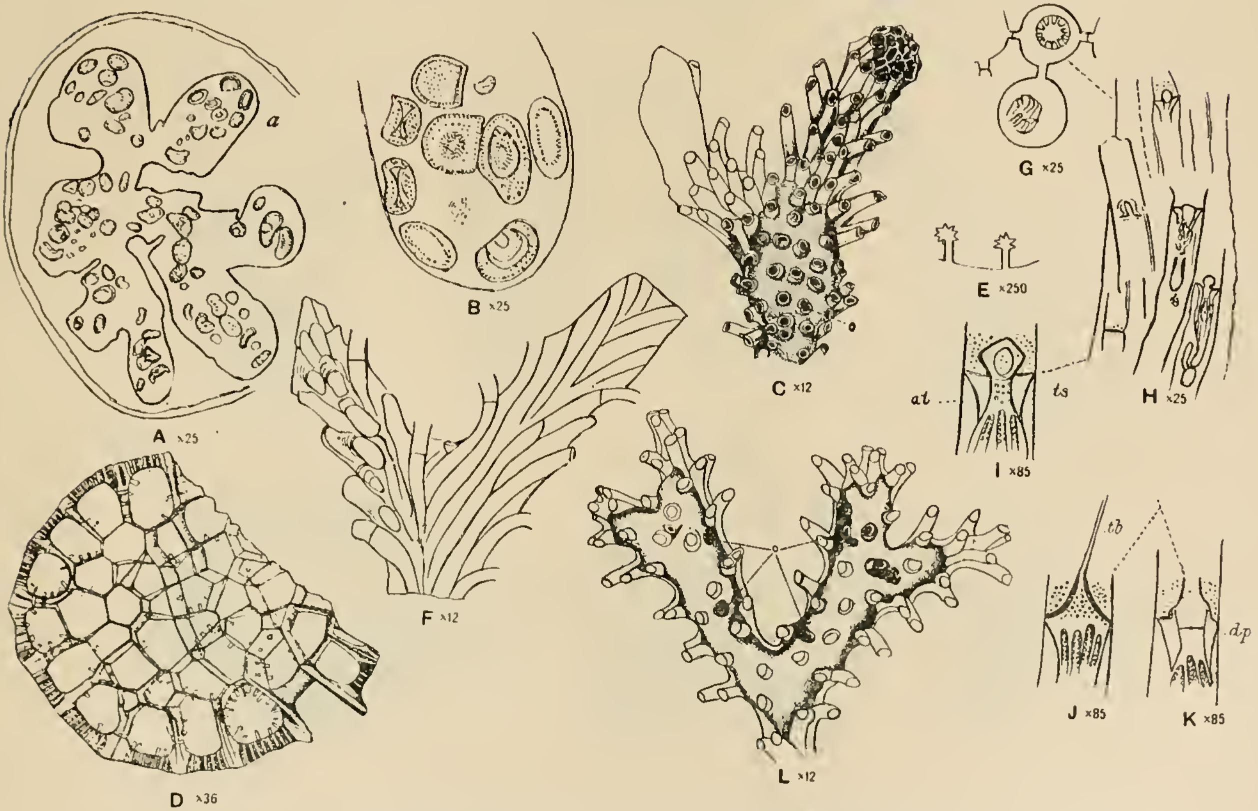


FIG. 239.—Anatomy of the Diaperoeciidae Canu, 1918.

A, B. *Diplosolen intricaria* Smitt, 1871. A. Section through ovicell, × 25, containing a large number of small embryos. B. Section of lobe *a* of the same ovicell. (After Waters, 1900.)

C–E. *Diaperoecia intricaria* Busk, 1875. C. Ovicelled zoarium, × 12 (*o*, oeciostome). After Harmer, 1915.) D. Transverse section through a zoarium, × 36, showing in the tubes a large number of minute rays with club-shaped heads, on which there are numerous tubercles. E. Rays included in the tubes, × 250.

F. *Diaperoecia rugosa* Waters, 1878. Longitudinal section through a zoarium, × 12. The most usual position for the calcareous plate which closes the tube would seem to be about the point where the zooecial tube rises free from the zoarium. (D–F after Waters, 1884.)

G–K. *Diaperoecia regularis* MacGillivray, 1882. G. Transverse section, × 25, showing connection through tubes divided by a disk. H. Longitudinal decalcified section, × 25, showing thick membranous transverse wall. I. The thick membrane projects in the middle, but is not closed below, × 85. *ts*, tentacular sheath; *at*, tissue attached to the tentacular sheaths and to the zooecial wall. J. There is a thin tube (*tb*) arising from the transverse membrane, × 85. K. Appearance of the diaphragm (*dp*) closing the tentacular sheath. (G–K, after Waters, 1905.)

L. *Diaperoecia pulcherrima* Kirkpatrick, 1890. Many ovicells are reunited; they form only one ovicell with many oeciostomes (*o*). (After Harmer, 1915.)

### Genus DIAPEROECIA Canu, 1918.

1918. *Diaperoecia* Canu, Les ovicelles des bryozoaires cyclostomes, Bulletin de la Société Geologique, France, ser. 4, vol. 16, p. 329.

No adventitious tubes; 10 to 12 tentacles.

*Genotype.*—*Diaperoecia* (*Entalophora*) *intricaria* Busk, 1875.

*Range.*—Cretaceous-Recent.

Waters in 1914 preserved the term "*Diastopora*". for this genus as we now understand it. The new ideas necessitate a new nomenclature to avoid all confusion, but the insufficiency of the present studies oblige us to preserve provisionally the old nomenclature; it is necessary, therefore, to consider the ancient genera under their best known significance. It is probable that this genus will be dismembered according to the form of the oeciostome. Thus the Cretaceous forms appear to have a very small oeciostome scarcely salient; if this observation be confirmed, it will be necessary to create a new genus for them.

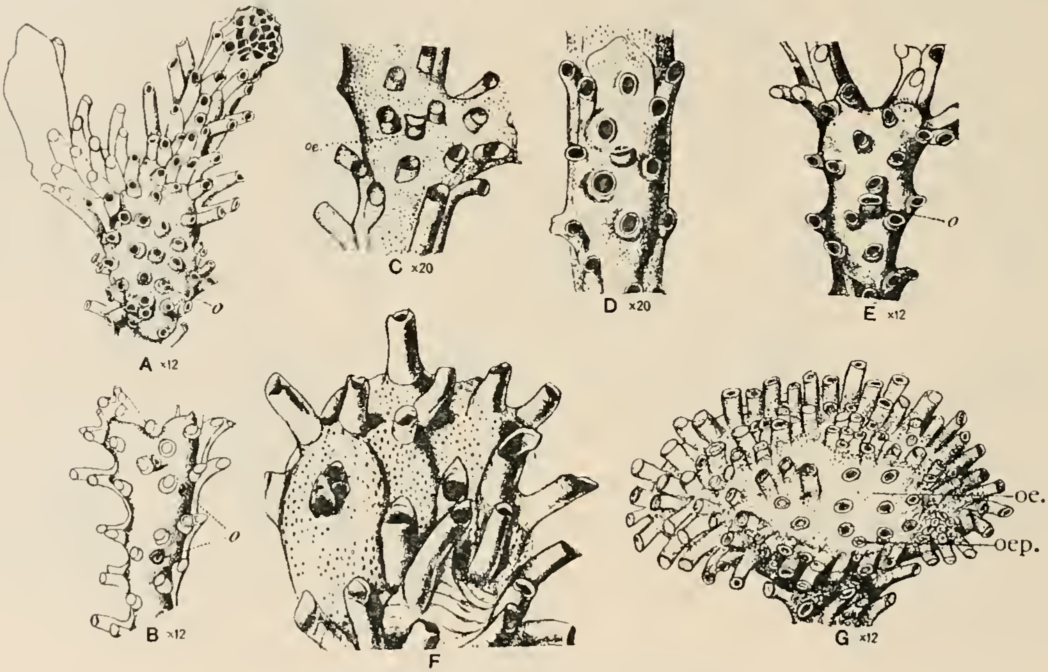


Fig. 240.—Genus *Diaperoecia* Canu, 1918.

A–G. Views of ovicelled zoaria showing the oeciostome. A. *Diaperoecia intricaria* Busk, 1875. B. *Diaperoecia pulcherrima* Kirkpatrick, 1890. (A, B. After Harmer, 1915.) C–E. *Diaperoecia interjuncta* MacGillivray, 1885. (After Waters, 1914, 1887, and Harmer, 1915.) F. *Diaperoecia ventricosa* Busk, 1875. G. *Diaperoceia capitata* Robertson, 1910.

The previously known species belonging to this genus are:

*Entalophora regularis* MacGillivray. Recent.

*Entalophora capitata* Robertson, 1910. Recent.

*Entalophora interjuncta* MacGillivray, 1885. Recent.

*Entalophora rugosa* Waters, 1879. Recent.
*Idmonea radicata* Kirkpatrick, 1888. Recent.
*Tubulipora pulcherrima* Kirkpatrick, 1890. Recent.
*Tubulipora cassiformis* Harmer, 1915. Recent.
*Proboscina expansa* Hincks, 1880. Recent.
*Diastopora cristata* MacGillivray, 1886. Recent.
*Proboscina johnstoni* Hincks, 1880. Recent.
*Alecto dilatans*, Busk, 1850. Pliocene-Recent.
*Entalophora palmata* Busk, 1852. Miocene-Pliocene.
*Diastopora flabellum* Reuss, 1847. Helvetian-Tortonia.
*Berenicea papillosa* Reuss, 1847. Cretaceous.
*Berenicea congesta* Reuss, 1846. Cretaceous.
*Entalophora echinata* Römer, 1840. Cretaceous.
*Berenicea polystoma* Römer, 1839. Cretaceous.
*Discosparsa varians* Ulrich, 1901. Upper Cretaceous-Eocene.

All our American species form a perfectly homogeneous group; their oeciostome is always transversely elliptical, adjacent to a tube and directed downward. This function of the escapement of the larva appears most important and sufficient to justify the formation of different genera.

### DIAPEROECIA VARIANS Ulrich, 1901.

Plate 104, figs. 1–4.

1901. *Discosparsa varians* ULRICH, Maryland Geological Survey, Eocene, p. 205, pl. 59, fig. 3.

*Description.*—The zoarium is discoidal or tubular; it incrusts algae or surrounds their small fronds. The tubes are indistinct, arranged in quincunx; the peristomes are salient, orbicular, very close to one another. The ovicell is smooth, nonglobular, traversed by the tubes; the oeciostome is transverse, elliptical, placed in the vicinity of a tube.

*Affinities.*—This species appears to have some relations with the group of *Cellulipora* D'Orbigny, 1852. Unfortunately, that genus is still insufficiently studied. On the other hand, on account of the form and arrangement of its oeciostome, this species will serve later as genotype for a new genus when analogous species have been discovered.

*Occurrence.*—Lowest Eocene (Bryozoan bed at base of the Aquia formation): Upper Marlboro, Maryland (rare).

*Geological distribution.*—Cretaceous (Vincentown [Danian]) Vincentown, New Jersey (Ulrich).

*Plesiotypes.*—Cat. No. 65456, U.S.N.M.

### DIAPEROECIA LONGICAUDA, new species.

Plate 115, figs. 7, 8.

*Description.*—The zoarium incrusts bryozoa; it spreads out flabelliform at the extremity of uniserial, long branches. The tubes are visible, convex, cylindrical, or clavate, striated transversally, bent upward at their extremity and terminated by a more or less salient peristome; the peristome is orbicular and thick. The ovicell is large, transverse, globular, traversed by the tubes which conserve their reciprocal positions.

| | | |
|---|---|---|
| *Measurements.*— | Diameter of the peristome | 0.10–0.12 mm. |
| | Zooecial diameter | 0.20 mm. |
| | Distance between the orifices | 0.40 mm. |
| | Separation of the peristomes | 0.40 mm. |
| *Measurements of Stomatoporoid portion.*— | Diameter of the peristome | 0.10 mm. |
| | Zooecial diameter | 0.16 mm. |
| | Distance between the orifices | 0.50–0.60 mm. |

The micrometric measurements of this species are quite variable; those which we give are quite approximative.

*Affinities.*—The species is very remarkable in its zoarial aspect which appears more often like a palm leaf at the end of a *long stem*. In the old zoarial classification it would be impossible to give this species a generic name, since it affects successively the forms of *Stomatopora*, *Proboscina*, and *Berenicea*. This phenomenon has been noted, moreover, rather frequently in the literature, and a most convincing example was figured by Hincks as long ago as 1880 in *Stomatopora johnstoni*.

*Occurrence.*—Middle Jacksonian (Castle Hayne limestone): Wilmington, North Carolina (very rare).

*Holotype.*—Cat. No. 65276, U.S.N.M.

### DIAPEROECIA JACKSONIENSIS, new species.

Plate 121, figs. 12–13.

*Description.*—The zoarium incrusts shells in claviform branches. The tubes are distinct, cylindrical, arranged in quincunx, finely punctate, with the peristomie salient, oblique, and elevated to 60°; the peristome is orbicular, oblique. The ovicell is salient, globular, inclosing a dozen tubes; the oeciostome is elliptical, little salient, joined to a tube.

| | | |
|---|---|---|
| *Measurements.*— | Diameter of the peristome | 0.12 mm. |
| | Distance between the peristomes | 0.60 mm. |
| | Width of the zoarium | 1.7 mm. |

The figured specimen is the only one that has been discovered.

*Occurrence.*—Lower Jacksonian (Moodys marl): Jackson, Mississippi (very rare.)

*Holotype.*—Cat. No. 65302, U.S.N.M.

### DIAPEROECIA LOBULATA, new species.

Plate 122, figs. 1–7.

*Description.*—The zoarium is free and tubular or incrusts shells; it is formed of successive, flabellate *lobules* more or less symmetrically arranged on each side of the ancestrula. The tubes are distinct, cylindrical or horn-shaped, nearly rectilinear, arranged in quincunx, very slightly striated; the peristomie is very salient, raised at the center, quite oblique on the zoarial margins; the peristome is elliptical, horizontal. The ovicell is globular, salient, transverse, elliptical, located on the zoarial margin. No zone of growth.

| | | |
|---|---|---|
| *Measurements.*— | Diameter of the peristome | 0.10–0.14 mm. |
| | Distance between the peristomes | 0.30–0.40 mm. |
| | Separation of the peristomes | 0.20–0.24 mm. |

*Variations.*—The ovicell is almost always placed on the zoarial margin; however, when the lobe is large and developed, it may be placed in the middle, and is oriented more or less longitudinally.

The secondary lobes do not originate from the preceding one by dichotomization as in *Proboscina;* they are produced by rejuvenescence—that is to say, by the development around a single marginal tube of the preceding lobe, serving thus as a pseudo-ancestrula.

The zone of growth is very narrow and scarcely visible.

This species is very prolific; one of our specimens shows three successive and parallel ovicells on the same tube.

The tubes are very often horn-shaped and consequently narrowed in their proximal portion.

*Affinities.*—In its micrometric measurements this species is quite close to *Plagioecia botula*, but it differs in its zoarial form of successive lobules and in the very different nature of its ovicell.

*Occurrence.*—Middle Jacksonian: Wilmington, North Carolina (rare); Rich Hill, five and one-half miles southeast of Knoxville, Crawford County, Georgia (common).

*Cotypes.*—Cat. Nos. 65426, 65427, U.S.N.M.

### DIAPEROECIA LOBULATA, var. PARVIPORA, new variety.

Plate 122, figs. 8, 9.

This variety presents the essential characters of the species—marginal ovicell and successive lobules produced by rejuvenescence. The only difference is in the diameter of the peristome, which measures only 0.06–0.08 mm.

*Occurrence.*—Middle Jacksonian: Near Lenuds Ferry, South Carolina (very rare); Eutaw Springs, South Carolina (very rare).

*Holotype.*—Cat. No. 65428 U.S.N.M.

### DIAPEROECIA RUGOSA, new species.

Plate 153, figs. 5–8.

*Description.*—The zoarium incrusts shells and especially cheilostomatous bryozoa; it emits short, foliaceous, bilamellar expansions. The tubes are indistinct, arranged in regular quincunx, garnished with large transverse, overlapping, widely spaced *wrinkles*, and are terminated by a very short, oblique peristomie. The peristome is elliptical, thin, horizontal. The ovicell is globular, placed around some tubes, ornamented with wrinkles like the tubes.

| *Measurements.*— | | |
|---|---|---|
| | Diameter of the peristome | 0.10 mm. |
| | Distance between the peristomes | 0.60 mm. |
| | Separation of the peristomes | 0.40–0.50 mm. |

This superb species is well characterized.

*Occurrence.*—Vicksburgian (Marianna limestone): Three miles southeast of Vosburg, Jasper County, Mississippi (rare).

*Holotype.*—Cat. No. 65381, U.S.N.M.

### DIAPEROECIA ORBICULATA, new species.

Plate 153, figs. 9–15.

*Description.*—The zoarium is free, large, *orbicular;* the basal lamella is striated concentrically. The tubes are distinct, cylindrical, rectilinear, arranged in quincunx or more often in irregular radial rows; the peristome is thin, orbicular, very oblique. The ovicell is large, transversely elliptical, more or less distant from the zoarial margins.

| *Measurements.*— | | |
|---|---|---|
| | Diameter of the peristome | 0.10 mm. |
| | Separation of the peristomes | 0.36 mm. |
| | Distance between the peristomes in quincunx | 0.40–0.50 mm. |
| | Distance between the peristomes in rows | 0.25–0.30 mm. |

This beautiful species is admirably characterized by its zoarium in the *Discoparsa* form and by its zooecia arranged in radial rows. We have discovered one specimen with an absolutely smooth ovicell.

*Occurrence.*—Vicksburgian (Marianna limestone): One mile north of Monroeville, Alabama (very common).

*Cotypes.*—Cat. No. 65382, U.S.N.M.

### DIAPEROECIA CLAVA, new species.

Plate 154, figs. 1–9.

*Description.*—The zoarium is a multiserial, thick *Proboscina* form in which the branches are short or elongated and are in the form of a *club;* it incrusts shells, bryozoa, Orbitoid foraminifera, and algae. When the zoarium is free, the basal lamella is striated transversally. The tubes are indistinct, arranged in regular quincunx, terminated by a very salient peristomie and elevated almost vertically. The peristome is orbicular, thick, sharp. The ovicell is very large, very globular, irregularly elliptical; the oeciostome is elliptical, transverse, directed proximally, adjacent to a tube. The zone of growth is very thick.

| *Measurements.*— | | |
|---|---|---|
| | Diameter of the peristome | 0.10–0.12 mm. |
| | Diameter of the apertura | 0.06–0.08 mm. |
| | Distance between the peristomes | 0.30 mm. |
| | Separation of the peristomes | 0.30–0.36 mm. |
| | Width of the branches | 1.5 mm. |

*Variations.*—The zoarial variations are in rapport with the substratum. On the shells, the branches are always longer and the zoaria more complete; on the algae the branches are broken and detached from one another in fossilization.

The aspect of the ovicell varies with the width of the branches and the number of the tubes surrounded.

*Occurrence.*—Vicksburgian (Marianna limestone): Salt Mountain, 5 miles south of Jackson, Alabama (very common); near Claiborne, Monroe County, Alabama (rare); Murder Creek, east of Castlebury, Conecuh County, Alabama, (rare); west bank Conecuh River, Escambia County, Alabama (rare).

Vicksburgian (Red Bluff clay): One-fourth of a mile west of Woodwards, Wayne County, Mississippi (rare).

*Cotypes.*—Cat. Nos. 65383, 65384, U.S.N.M.

### DIAPEROECIA WALCOTTI, new species.

Plate 154, figs. 10, 11.

*Description.*—The zoarium has the form of a multiserial *Proboscina;* it incrusts orbitoid foraminifera in clavate branches. The tubes are distinct, cylindrical, very irregularly arranged, slightly striated, terminated by a peristomie little salient and bent upward; the peristome is thin, orbicular, horizontal. The ovicell is little salient; the oeciostome is adjacent to a normal tube.

*Measurement.*—Diameter of the peristome------------------- 0.10–0.12 mm.

We dedicate this species to Dr. Charles D. Walcott, Secretary of the Smithsonian Institution.

*Occurrence.*—Vicksburgian (Marianna limestone): West bank, Conecuh River, Escambia County, Alabama (rare).

*Holotype.*—Cat. No. 65385, U.S.N.M.

### Genus DIPLOSOLEN Canu, 1918.

1918. *Diplosolen* CANU, Les ovicelles des bryozoaires cyclostomes, Bulletin Société Geologique de France, ser. 4, vol. 16, p. 329. (Proposed for *Diplopora* JULLIEN, 1886, preoccupied.)

Adventitious tubules are present. The oeciostome is isolated. 12 tentacles.

*Genotype.*—*Diplosolen* (*Berenicea*) *obelium* Johnston, 1847.

*Range.*—Senonian-Recent.

According to Waters the tubules are developed at the same time that a second calcareous layer is superposed on the normal skeleton.

The previously described species belonging to this genus are:

*Berenicea obelia* Johnston, 1838. Helvetian-Recent.

*Reticulipora intricata* Smitt, 1867. Recent.

*Reticulipora transcennata* Waters, 1884. Priabonian.

*Diastopora compacta* Canu, 1909. Lutetian.

*Diastopora lineata* Gabb and Horn, 1865. Cretaceous (Vincentown).

*Diastopora obelioides* Pergens, 1889. Coniacian.

The term "*Diplopora*" of Jullien has been preoccupied two or three times.

### **DIPLOSOLEN COMPACTUM, new species.**

Plate 103, figs. 15–17.

*Description.*—The zoarium incrusts stones; it emits tubular unilamellar expansions. The tubes are distinct, cylindrical, flat; the peristome is elliptical. horizontal, often closed by a finely punctate calcareous lamella. The adventitous tubules are primoserial. The ovicell is large, spread over a score of tubes, little globular, punctate; the oeciostome is small, isolated, little salient; each tube perforating the ovicell is accompanied by its zooeciule.

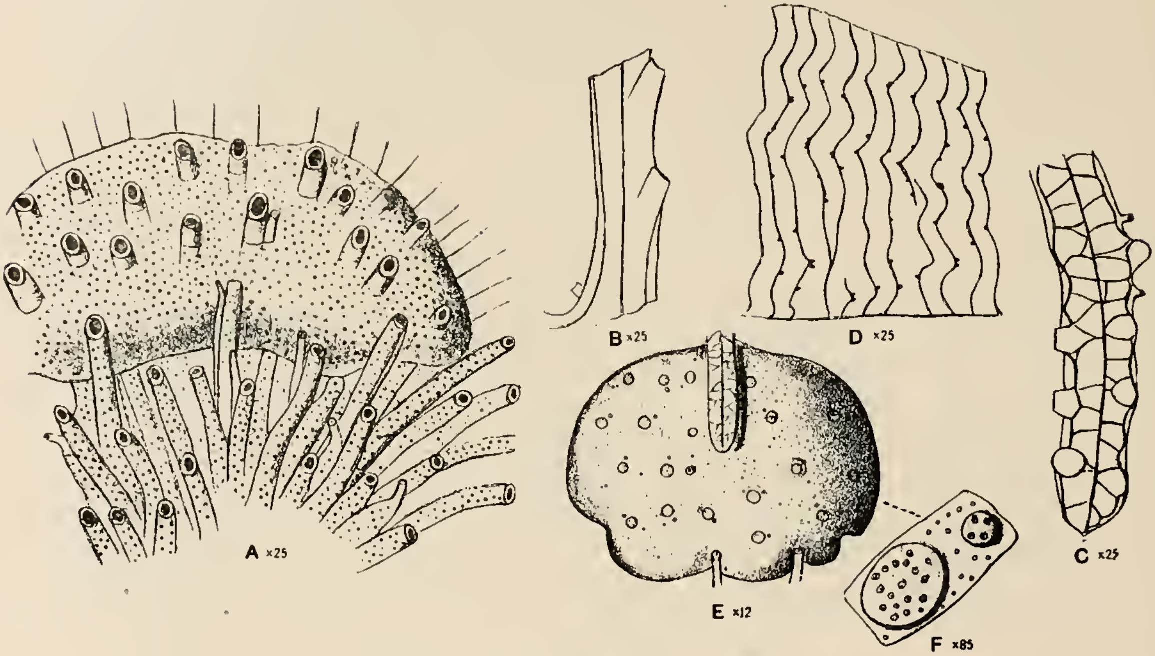


Fig. 241.—Genus *Diplosolen* Canu, 1918.

A–F. *Diplosolen obelia* var. *arctica* Waters. A. Zoarium showing the adventitious tubules and the ovicell, × 25. B. Calcareous longitudinal section, showing the outer calcareous wall beyond the zooecia, × 25. C. Transverse section, × 25. D. Calcareous section, × 25, showing the irregular wavy position of the zooecial tubes and also showing small internal projections. E. Ovicell with one oeciostome, × 12. At the upper part of the ovicell the base of a lateral branch is enclosed. F. The end of a zooecium and of an adventitious tubule, × 85, both with closures. From the ovicell of Fig. E. (A–F, after Waters, 1900.)

| | | |
|---|---|---|
| *Measurements.*— | Diameter of the peristome | 0.10 mm. |
| | Distance between the peristomes | 0.35 mm. |
| | Separation of the peristomes | 0.40 mm. |

This species is quite well characterized by the nearness of its peristomes and by its primoserial zooeciules.

*Occurrence.*—Lowest Eocene (Bryozoan bed at the base of the Aquia formation). Upper Marlboro, Maryland (rare).

*Holotype.*—Cat. No. 65240, U.S.N.M.

### DIPLOSOLEN PLANUM, new species.

Plate 122, figs. 14–16.

*Description.*—The zoarium is free and bilamellar. The tubes are little distinct, *flat*, oval, arranged in irregular quincunx, much scattered; the peristome is elliptical, thin, horizontal, often closed by a porous calcareous lamella. The adventitous tubules are indistinct, terminated by an elliptical aperture, arranged above each tubular peristome. The ovicell is convex, suborbicular, spread over a dozen tubes.

| | | |
|---|---|---|
| *Measurements.*— | Diameter of the peristome | 0.08–0.10 mm. |
| | Diameter of the tubes | 0.14–0.16 mm. |
| | Distance between the peristomes | 0.70–0.80 mm. |
| | Separation of the peristomes | 0.50–0.55 mm. |

*Affinities.*—This species resembles *Diplosolen obelium* Johnston, 1847; it differs from it in its flat tubes, bilamellar zoarium, and scarcely visible zooeciules.

*Occurrence.*—Middle Jacksonian: Near Lenuds Ferry, South Carolina (rare).

*Holotype.*—Cat. No. 65430, U.S.N.M.

### LEKYTHIONIA, new genus.

Greek: *Lekythion*, small flask; in allusion to the form of the oeciostome.

The ovicell is not perforated by the adventitious tubules. The oeciostome is isolated, oval, in the form of a bottle or flask.

*Genotype.*—*Lekythionia* (*Reticulipora*) *dichotoma* Gabb and Horn, 1862.

*Range.*—Upper Cretaceous, Lower Eocene.

### LEKYTHIONIA DICHOTOMA Gabb and Horn, 1862.

Plate 104, figs. 7–13.

1862. *Reticulipora dichotoma* Gabb and Horn, Monograph Fossil Polyzoa Secondary and Tertiary Formations of North America, Journal Academy Natural Science, Philadelphia, ser. 2, vol. 5, p. 173, pl. 21, fig. 64.

1901. *Reticulipora dichotoma* Ulrich, Maryland Geological Survey, Eocene, p. 207, pl. 59, figs. 9–12.

1907. *Reticulipora dichotoma* Weller, Cretaceous Faunas, Geological Survey New Jersey, Paleontology, vol. 4, p. 318, pl. 21, figs. 5–14.

*Description.*—The zoarium incrusts shells and stones; it emits bilamellar expansions produced by a folding of the primitive lobes; these expansions, with the large zone of growth develop very irregularly and anastomose in a very complicated network. The tubes are indistinct, arranged in quincunx or in little constant rows. The tubules are irregularly arranged on the zoarium. The ovicell is orbicular or elliptical, not convex, spread among a dozen tubes, not perforated by the adventitious tubules; the oeciostome is isolated, oval, provided with an oeciostome more or less large.

*Measurement.*—Maximum diameter of the peristome ______________ 0.12 mm.

We have little to add to the excellent description given in 1901 by Ulrich, but the progress of science permits us to understand the structure of the species better.

The tubules are more interstitial than adventitious, for they do not perforate the ovicell.

*Occurrence.*—Lowest Eocene (Bryozoan bed at base of the Aquia formation): Upper Marlboro, Maryland (rare).

*Geological distribution.*—Cretaceous (Vincentown): Vincentown, New Jersey.

*Plesiotypes.*—Cat. No. 65457, U.S.N.M.

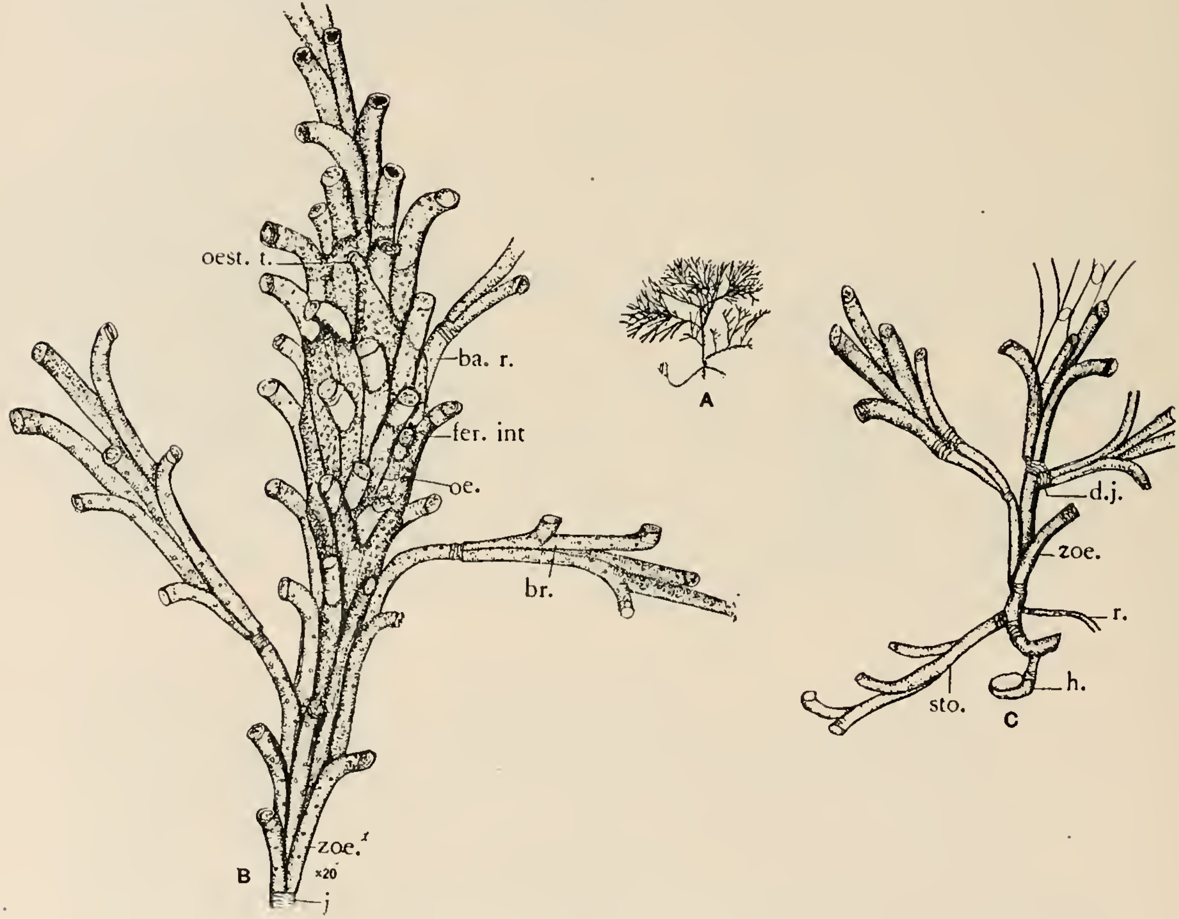


Fig. 242.—Genus *Crisulipora* Robertson, 1910.

A–C, *Crisulipora occidentalis* Robertson, 1910. A, Zoarium, natural size. B. An ooecial internode, × 20, showing its origin in two zooecia in whose walls the first chitinous joint (*j*) occurs, and the mode of formation of three branches; also, the ooecium (*oc*) distinguished by its coarsely punctate wall, with the tubular aperture (*oest. t.*) and circular oeciopore. The tubes at the distal extremity of the internode, the proximal portions of which only are shown, give rise to another internode. C. A portion of the lower part of a colony showing a rootlet (*r*) which grows long, penetrating masses of other material; another which is shorter and possesses a hook (*h*) or process which has laid hold of a grain of sand or a pebble; and a stolonlike process (*sto*) which grows horizontally sending up zooecia at intervals which produced new branches. From the first zooecium (*zoc*) there arise two tubes one of which gives rise to a double joint (*dj.*) giving off branches at an angle to each other and hence in different directions. (A–C, after Robertson, 1910.)

### Genus CRISULIPORA Robertson, 1910.

1910. *Crisulipora* ROBERTSON, The Cyclostomatous Bryozoa of the West Coast of North America, University of California Publications Zoology, vol. 6, p. 254.

Zoarium dendroid, calcareous, composed of segments or internodes united by chitinous joints. Zooecia tubular, disposed in several alternate rows. Ooecium an inflation of the surface of an internode. (Robertson) Oeciostome tube narrower than the zooecial tube, without any terminal expansion. Ten tentacles (Waters).

*Genotype.—Crisulipora occidentalis* Robertson, 1910.

*Range.*—Vicksburgian-Recent.

#### CRISULIPORA PROMINENS, new species.

Plate 154, figs. 12–20.

*Description.*—The segments are thin, elongated, somewhat claviform, triserial. The tubes are distinct, cylindrical, bent upward, terminated by a *salient* peristomie elevated to 45°; the peristome is thin, salient, orbicular, oblique. The ovicell is sacciform, globular, striated transversally, the oeciostome is a tube smaller and less salient than an ordinary tube, directed upward. The basal lamella is ornamented with transverse, much scatered wrinkles.

| *Measurements.*— | | |
|---|---|---|
| | Diameter of the peristome | 0.12 mm. |
| | Distance between the peristomes | 0.40–0.60 mm. |
| | Separation of the peristomes | 0.60 mm. |
| | Length of the peristomie | 0.20 mm. |
| | Width of the segments | 0.60–0.80 mm. |

*Variations.*—The segments of the base of the zoarium are not similar to the others; they are more simple and biserial. The length and width of the segments are quite variable just as is their general aspect; we have figured some of them.

This species differs from *Crisulipora rugosodorsalis* in its segments which are triserial and not pluriserial, and in the dimensions of its much smaller ovicell.

*Occurrence.*—Vicksburgian (Marianna limestone): One mile north of Monroeville, Alabama (very rare); West bank Conecuh River, Escambia County, Alabama (rare).

*Cotypes.*—Cat. Nos. 65386, 65387, U.S.N.M.

#### CRISULIPORA RUGOSODORSALIS, new species.

Plate 154, figs. 25–29.

*Description.*—The segments are pluriserial, fusiform, swollen. The tubes are distinct, cylindrical, curved, arranged in regular quincunx, terminated by an oblique salient peristomie; the peristome is thick, orbicular, little oblique. The ovicell is very convex, voluminous, punctate and striated transversally, surrounding almost all the tubes of a segment; the oeciostome is a smaller tube adjacent to another. The dorsal face is ornamented with large, transverse, scattered *wrinkles;* it is very often concave.

| | | |
|---|---|---|
| *Measurements.*— | Diameter of the peristome | 0.10–0.12 mm. |
| | Diameter of the apertura | 0.08 mm. |
| | Distance between the peristomes | 0.40 mm. |
| | Separation of the peristomes | 0.50–0.60 mm. |
| | Length of the peristome | 0.20 mm. |
| | Width of the segments | 1.00 mm. |

*Affinities.*—This species differs from *Crisulipora prominens* in its pluriserial zoarium. It differs from *Crisulipora flabellata* in its dorsal surface, which is much more rugose, and in its nonflabelliform but fusiform and never bifurcated segments.

*Occurrence.*—Vicksburgian (Marianna limestone): One mile north of Monroeville, Alabama (rare); west bank Conecuh River, Escambia County, Alabama (rare).

*Cotypes.*—Cat. Nos. 65389, 65390, U.S.N.M.

### CRISULIPORA FLABELLATA, new species.

Plate 154, figs. 21–24.

*Description.*—The segments are pluriserial, flabellate, bifurcated. The tubes are distinct, cylindrical, arranged in irregular quincunx, striated; the peristome is thin, orbicular; the peristomie is well developed only on the lower tubes. The ovicell is enormous, globular, enveloping all the tubes of a segment; the oeciostome is very small. The dorsal face (basal lamella) is ornamented with transverse, very widely scattered striae.

| | | |
|---|---|---|
| *Measurements.*— | Diameter of the peristome | 0.12 mm. |
| | Distance between the peristomes | 0.60 mm. |
| | Separation of the peristomes | 0.50–0.60 mm. |
| | Width of the segments | 1.6 mm. |

*Affinities.*—This species differs from *Crisulipora rugosodorsalis* in the flabellate (and not fusiform) form of its segments, and in its dorsal face ornamented with much smaller wrinkles. We learn from Miss Robertson's work that the number of the embryos is very great in the ovicell of *Crisulipora.* On the other hand, if we note the great size of the ovicell of this species we are surprised at the rarity of the specimens found. Their extreme fragility and their special mode of habitat on floating algae must be the cause of this.

*Occurrence.*—Vicksburgian (Marianna limestone): One mile north of Monroeville, Alabama (rare).

*Cotypes.*—Cat. Nos. 65388, 65483, U.S.N.M.

### CRISULIPORA GRANDIPORA, new species.

Plate 155, figs. 7–11.

*Description.*—We know only the biserial segments of the base of this species. The tubes are very long and very *large*, ornamented with small transverse widely spaced wrinkles; the peristome is thick, orbicular, salient.

| | | |
|---|---|---|
| *Measurements.*— | Diameter of the peristome | 0.20–0.24 mm. |
| | Diameter of the apertura | 0.12 mm. |
| | Distance between the peristomes | 1.20 mm. |
| | Width of the segments of the base | 0.26 mm. |

This species is not as rare as the preceding one, for we possess a score of fragments which has permitted us to make longitudinal sections. The tubes are arranged as in *Filisparsa.* We have supposed that these are the branches of the base of a *Crisulipora*, but the discovery of other segments is necessary.

D'Orbigny named this special arrangement of the biserial zoaria, *Unicrisia.*

*Occurrence.*—Vicksburgian (Marianna limestone): Murder Creek east of Castlebury, Conecuh County, Alabama (rare); west bank Conecuh River, Escambia County, Alabama (common).

*Cotypes.*—Cat. No. 65460, U.S.N.M.

### DESMEDIAPEROECIA, new genus.

The ovicell surrounds the fascicles. The surface of the tubes is ornamented with large pores closed by a calcareous lamella.

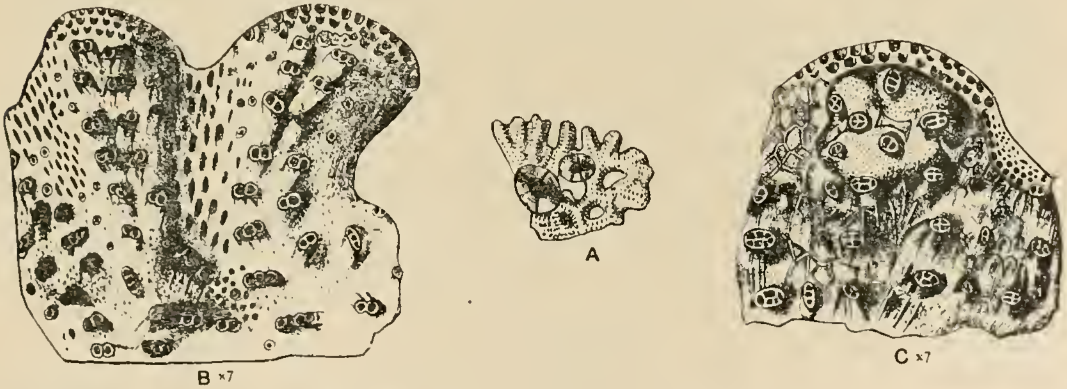


FIG. 243.—*Desmediaperoecia*, new genus.

A, B. Zoarium natural size and a portion, × 7, of *Desmediaperoecia* (*Tubulipora*) *biduplicata* Waters, 1887. C. Portion of zoarium, × 7, of *Desmediaperoecia* (*Tubulipora*) *campicheana* Waters, 1887 (not D'Orbigny).

*Genotype.*—*Desmediaperoecia* (*Tubulipora*) *campicheana* Waters, 1887. Miocene. Another species referred to this genus is *Desmediaperoecia* (*Tubulipora*) *biduplicata* Waters, 1887.

We have not observed the species mentioned by Waters, 1887, in the Tertiary of New Zealand. He figured the ovicell well, but did not speak of the oeciostome. It may be, therefore, that this genus would be more correctly classified in the Tubuliporidae.

## Family TUBULIPORIDAE Johnston, 1838.

*Anatomical bibliography.*—1838. MILNE-EDWARDS, Mémoire sur les Polypes du genre des Tubulipores, Annales des sciences naturelle, ser. 2, vol. 8, p. 3, pl. 12.—1877. BARROIS, Recherches sur l'embryologie des Bryozoaires, Travaux de l'Institut de Zoologie, fasc. 1, pl. 3, fig. 20.—1898. HARMER, On the development of Tubulipora, Quarterly Journal Microscopical Science, vol. 41, pp. 73–117, pls. 8, 9, 10.—1888. WATERS, On some Ovicells of Cyclostomatous Bryozoa, Journal Linnean Society, London, vol. 20, p. 275, pl. 14, figs. 2, 5, 6, 8.—1914. WATERS, Bryozoa from Zanzibar, Proceedings of the Zoological Society, London, pp. 835, 846, pl. 2, figs. 6, 7, 8, 10.—1865. SMITT, Om Hafs bryozoernas utveckling och fettkropper, Oversight Kongl. Vetenskaps Akademiens, Forhandlungen, p. 20, pl. 4, figs. 9–14.

The ovicell is irregular and located on the zoarium. The oeciopore is subcentral. The tubes are very salient at their proximal extremity; they are isolated or fasciculate.

In studying the anatomy of *Tubulipora organisans* D'Orbigny, 1839, Jullien[1] wrote:

> J'ai vu que l'ovicelle constituait une vraie génésie femelle depourvue de polypide, contenant une très grande quantité d'ovules qui y sont fécondées et en sortent à l'état de larves dejà très developpées.

The limits of this family have never been very precise; all of the old authors understood it in a different sense, adding or eliminating genera according to their personal opinion. The zoarial form and the mode of aggregation of the tubes were the only characters studied. A discussion of priority is therefore useless, since we now regard the ovicell as the essential and most important character.

In the establishment of the new genera we must consider the form and position of the oeciopore, which is in rapport with the function of the escape of the larva. Unfortunately, very often sufficient material for a complete study is lacking. As in the Cheilostomata, we must also regard the function of calcification.

We consider the genus *Tubulipora* Lamarck, 1816, as quite a natural one and we accept the word "Tubuliporidae" for the family, although the genus *Idmonea* is the more important in time and in space.

*Classification of genera.*

| | | | | No tubules. | Tubules on 1 side. | Tubules on 2 sides. |
|---|---|---|---|---|---|---|
| Ovicell not lobed | | | | *Idmonea.* | *Idmidronea.* | |
| Ovicell lobed. | Ovicell dissymmetrical | | | *Tubulipora.* | | |
| | Ovicell subsymmetrical | Ovicell lateral | | | *Pleuronea.* | |
| | | Ovicell median | Elongate | *Platonea.* | *Mesonea.*<br>*Erkosonea.* | *Tretonea.* |
| | | | Suborbicular | *Centronea.* | | |

Many of the *Tubuliporidae* are provided with "pores" which are the orifices of the special tubes of whose function we are absolutely ignorant. We give them different names according to the case and to their nature, but we can consider them only as variations determined by the function of calcification. They appear to furnish secondary generic characters and nothing more.

---

[1] 1888. Mission scientifique du Cap Horn, p. 82.

### Genus TUBULIPORA Lamarck, 1816.

1816. *Tubulipora* LAMARCK, Historie naturelle des animaux sans vertèbres, vol. 2.

The ovicell is irregular, lobed, spread out between the fascicles. The tubes are quite salient, isolated or joined in fascicles, uniserial and irregular. The oeciostome is adjacent to a tube and the oeciopore is directed in a direction contrary to that of an apertura. Eleven or 12 tentacles. Gemmation generally peripheral.

*Genotype.*—*Tubulipora flabellaris* Fabricius, 1780.

*Range.*—Midwayan-Recent.

Harmer[1] defines the genus as follows:

> Zoarium with a distinct basal lamina, adnate or erect, beginning as a pyriform or flabelliform colony, which may become lobed by the division of the terminal membrane. Lobes short and adherent, or longer and dichotomously divided once or more often, sometimes becoming erect. Zooecia with a free, cylindrical, terminal portion; or connate in obliquely transverse series, in which they are separated by flat septa corresponding with the intersection of two cylindrical zooecia. The series are arranged alternately on opposite sides of the axial line of the lobe, but the transverse arrangement usually becomes radial in the distal part of the fertile lobes. Ovicell, an enlarged zooecium, which extends into the intervals between the parallel or radial series.
>
> *Genotype.*—*Tubulipora liliacea* Pallas, 1766. (=*Tubulipora serpens* authors).

Canu in 1916 explained why the change of *Tubulipora serpens* to *Tubulipora liliacea* is not acceptable. Moreover, this species is badly chosen as genotype of the genus, for it is the only one which has an idmoneiform zoarium; all the other species are more or less flabellate. We would rather prefer the *Tubulipora flabellaris* Fabricius, 1780, very well figured later, as the true genotype. It is indeed true that *Tubulipora serpens* is a *Tubulipora.* The genus *Idmonea* Lamouroux, 1821, is also quite distinct and is characterized by the form and position of its oeciopore.

#### TUBULIPORA MIDWAYANICA, new species.

Plate 107, fig. 1.

*Description.*—The zoarium is flabellate, small, free, living on algae. The fascicles are salient, crowded, uniserial, complete, radiating from the ancestrula. The tubes are invisible; the peristome is thin, round or polgonal.

*Measurements.*—
Diameter of the peristome 0.08 mm.
Diameter of the apertura 0.06 mm.
Distance between the peristomes 0.10 mm.

*Affinities.*—The only specimen found has been figured. The necessities of the generic classification oblige us to describe it, but it is difficult to establish its relations with the other known species, especially since it has no ovicell.

It differs from *Tubulipora flabellaris* Fabricius, 1780, in its complete and noninterrupted lines and in its much shorter tubes.

*Occurrence.*—Midwayan (Clayton limestone): One mile west of Fort Gaines, Georgia (very rare).

*Holotype.*—Cat. No. 65243, U.S.N.M.

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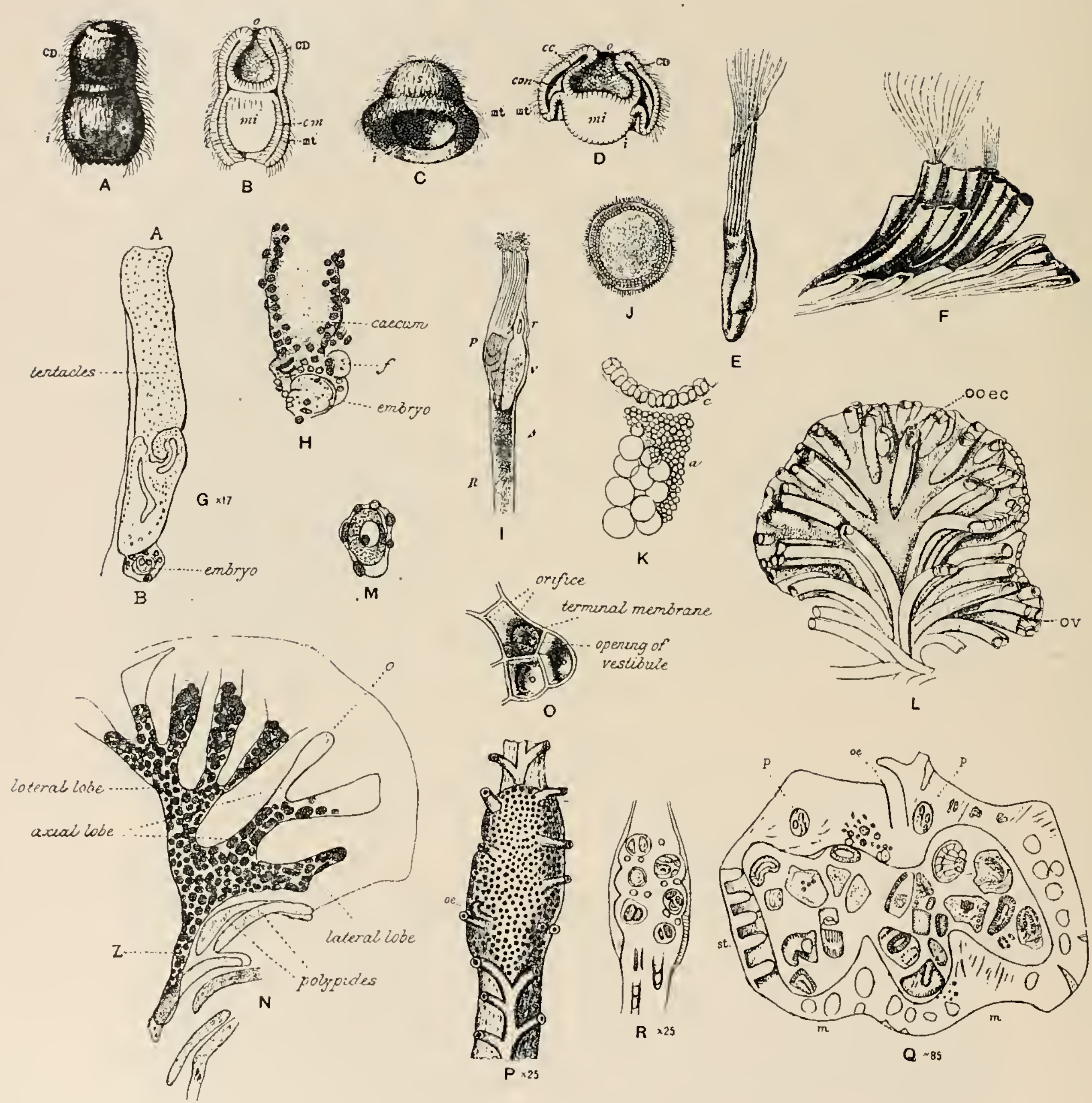
[1] 1898. Harmer, On the development of Tubulipora, Quarterly Journal Microscopical Society, n. s, vol. 41, p. 99.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opening of vestibule
O
o
lateral lobe
axial lobe
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Q ×85

Fig. 244.—Family Tubuliporidae Johnston, 1838.

Fig. 244.—Family Tubuliporidae Johnston, 1838.

A–D. *Tubulipora flabellaris* Fabricius, 1780. A, B. Free larva and optical section. C, D. Aspect of the embryo at the beginning of the narrowing, drawing the projection more and more strongly from the mesodermic thickening and from the mantle. *cd*, Digestive cavity; *cm*, triangular portion of the body cavity between the fatty mass and the pharynx and the stomach; *mt*, mantle; *mi*, fatty mass; *o*, orifice of the gastrula; *s*, oral face or from the vestibule. (A–D after Barrois, 1877.)

E–G. *Tubulipora phalangea* Couch, 1844. E. Polypide detached from the cell. F. Aspect of the zoarium with its polypides evaginated. (E, F, after Milne-Edwards, 1838.) G. Degeneration of the fertile polypide (stage B), × 17. The tentacles have lost their distinct outlines, and are obviously degenerating.

H. Stage B of *Tubulipora plumosa* Thompson, 1847, the embryo consisting of two blastomeres. The caecum of the fertile polypide (which has not yet degenerated) is seen; *f*. and the corresponding structure to the left are probably the degenerating follicles of eggs which are not developing. (After Harmer, 1898.)

I–K. *Tubulipora serpens* (Busk, Smitt, Hincks). I. Polypide detached from the cell. J. Ciliated embryo. (After Smitt, 1865.) K. Formation of the secondary embryos. *a*, primary and secondary embryos; *e*, wall of the stomach; *p*, pharynx; *R*, large retractor muscle of the polypide; *r*, anus; *t*, tentacles; *v*, stomach.

L–O. *Tubulipora plumosa* Thompson, 1847. L. Fertile lobe, with one ovicell and the beginning of a second ovicell; from a bilobed colony (proximal ends of oldest zooecia at the bottom of the figure, obscured by foreign substance. M. Ovarian egg, in follicle (stage A). N. Decalcified preparation of an old ovicell (stage G) with nearly solid embryophore containing numerous secondary embryos. The axial lobe of the embryophore ends in the oeciostome at *o*, and gives off another lobe to the right. The main lateral lobe of the right side is only obscurely bifurcated; that of its left side is divided into five lobes. *Z*, proximal part of the ovicell, corresponding with a zooecium. Greatest length of solid part of embryophore to tip of most projecting lobe, 2.5 mm.

O. Orifices (apertures) of living zooecia. The terminal membrane has been somewhat retracted. (L–O after Harmer, 1898.)

P–R. *Mesonea radians* Lamarck, 1816. P. An example, × 25, showing ovicells with oeciostome (*oc*). Q. Section from the anterior to the dorsal surface of the zoarium, × 85, showing the lobes of the ovicell and the oeciostome (*oc*) as well as the polypides (*p*). The structure of the wall of the ovicell is seen at the left (*st*) with one or two rosette plates at the base of the broad pore tube. There is an outer membrane (*m*). R. Longitudinal section of the ovicell, cut parallel to the anterior and dorsal surfaces. (After Waters, 1914.)

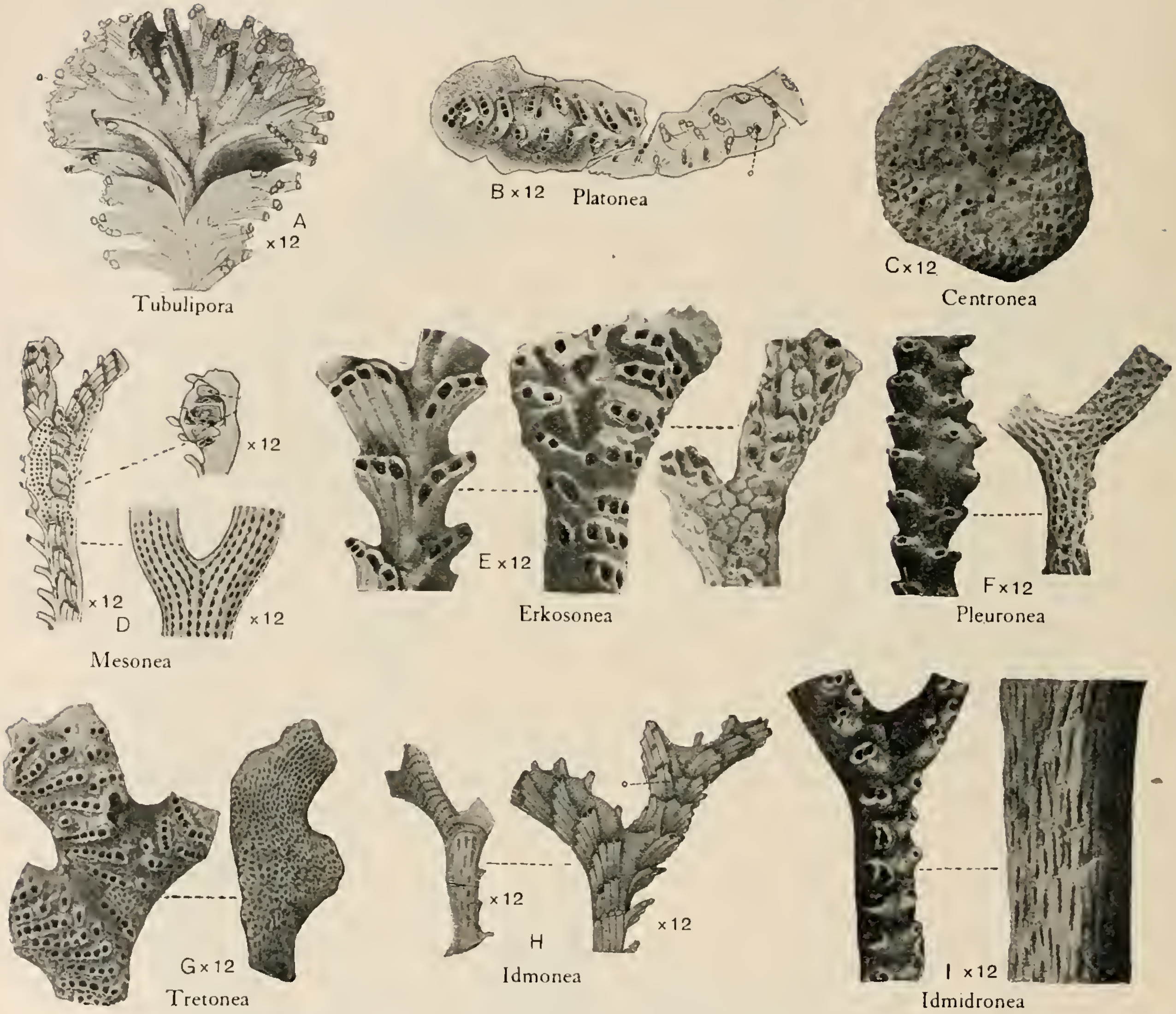

A
×12
Tubulipora
B ×12
Platonea
C×12
Centronea
×12
×12
D
×12
Mesonea
E ×12
Erkosonea
F×12
Pleuronea
G×12
Tretonea
×12
H
×12
Idmonea
I ×12
Idmidronea

FIG. 245.—Genera of the Tubuliporidae.

A. *Tubulipora* Lamarck, 1816. *Tubulipora phalangea* Couch.

B. *Platonea*, new genus. Ovicelled lobe of *Platonea* (*Reptotubigera*) *phillipsae* Harmer, 1915.

C. *Centronea*, new genus. Ovicelled specimen of *Centronea* (*Multitubigera*) *micropora* Reuss, 1869, × 12.

D. *Mesonea*, new genus. Frontal with ovicell and dorsal of *Mesonea* (*Retepora*) *radians* Lamarck, 1816.

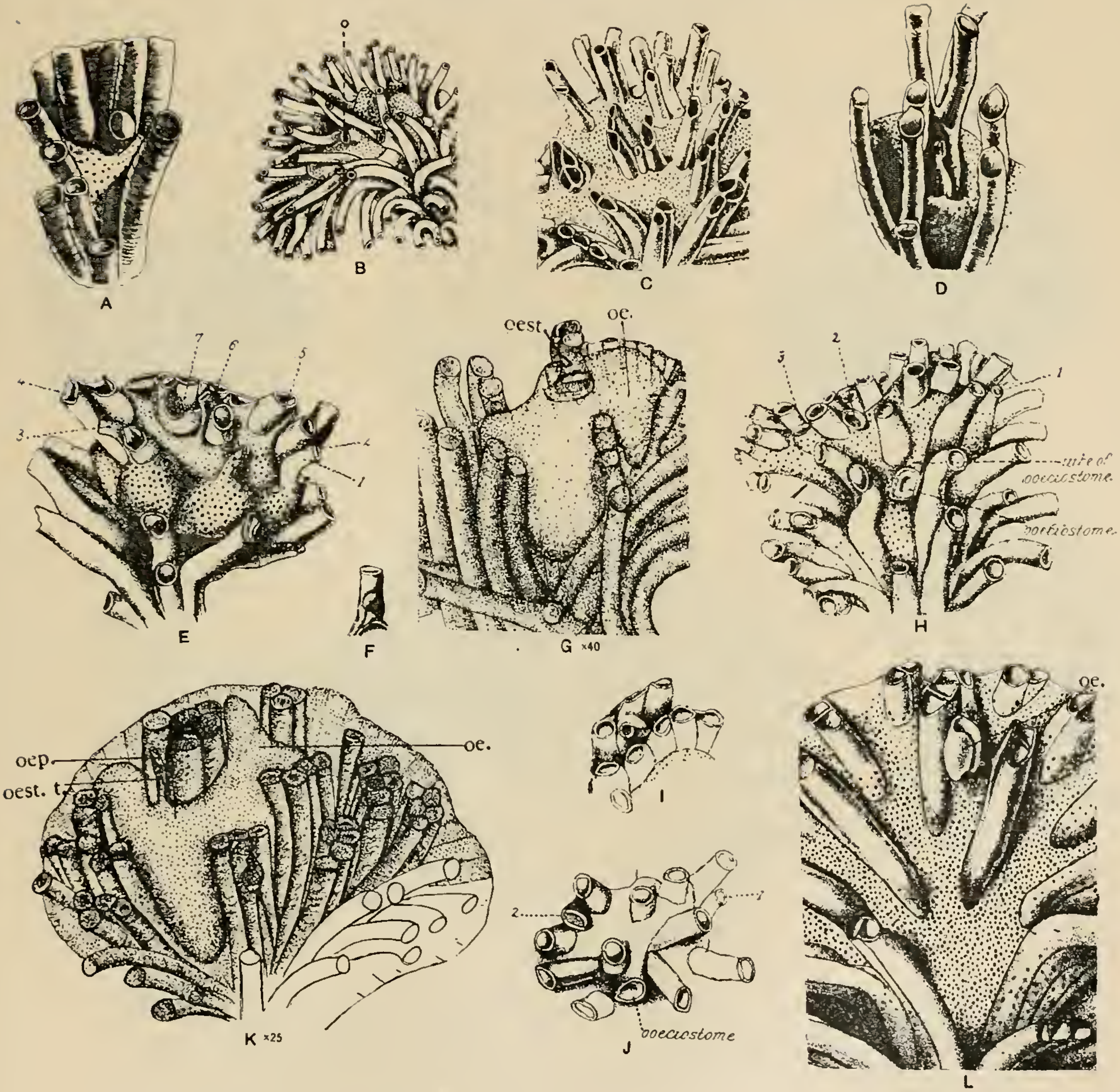
E. *Erkosonea*, new genus. Frontal and dorsal sides, × 12, of *Erkosonea semota*, new species from the Eocene of Mississippi.

F. *Pleuronea*, new genus. Frontal with ovicell and dorsal of *Pleuronea* (*Idmonea*) *fenestrata* Busk, 1859.

G. *Tretonea*, new genus. Frontal with ovicell and dorsal of *Tretonea levis*, new species from the Jacksonian of Georgia.

H. *Idmonea* Lamouroux, 1821. Dorsal and frontal with ovicell of *Idmonea atlantica* Forbes, 1859. (After Harmer, 1915.)

I. *Idmidronea*, new genus. Frontal, × 12, and dorsal, × 25, of *Idmidronea* (*Idmonea*) *maxillaris* Lonsdale, 1845, from the Eocene of North Carolina.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K ×25
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1
ooeciostome
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oe.
L

FIG. 246.—Oeciopores of *Tubulipora*.

A. *Tubulipora serpens* (Authors). (After Osburn, 1910.)
B. *Tubulipora concinna* MacGillivray, 1885 (*o*, ooecium). (After Harmer, 1915.)
C–E. *Tubulipora flabellaris* Fabricius, 1780. (After Smitt, Osburn, 1910, Harmer, 1898.)
F. *Tubulipora phalangea* Couch, 1844. (After Harmer, 1898.)
G. *Tubulipora pacifica*, Robertson, 1910 (*oc*, ooecium; *oest*, ooeciostome).
H–J. *Tubulipora aperta* Harmer, 1898.
K. *Tubulipora occidentalis* Robertson, 1910.
L. *Tubulipora plumosa* Thompson, 1847 (*oc*, ooeciostome).

### TUBULIPORA INTERRUPTA, new species.

Plate 134. fig. 22.

*Description.*—The zoarium is flabellate and incrusts bryozoa. The fascicles are little salient, irregular, interrupted by isolated tubes or by other incomplete series. The tubes are small, with a long but very oblique peristomie; the peristome is thin; the apertura is round or oval.

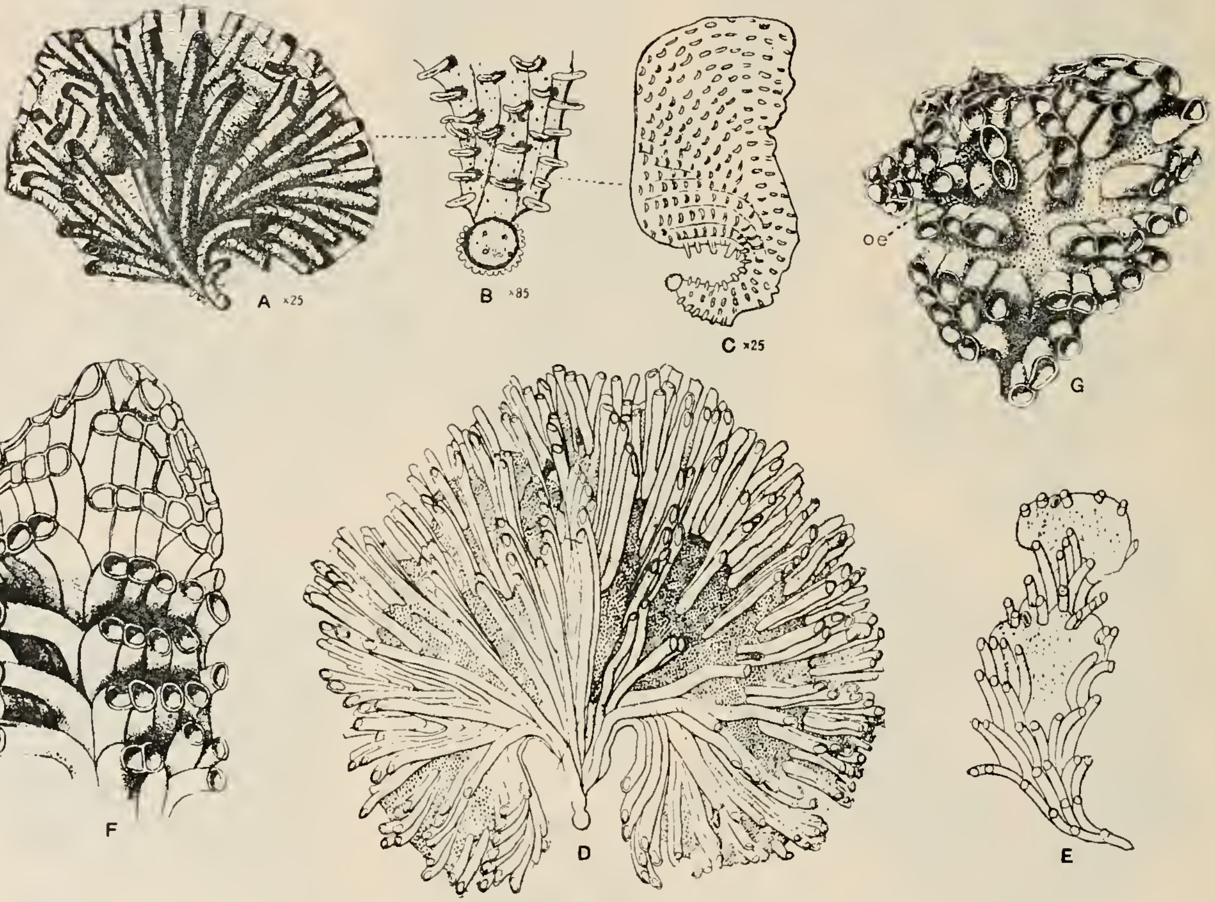

Fig. 247.—Genus *Tubulipora* Lamarck, 1816.

A–C. *Tubulipora pulchra* MacGillivray, 1885. A. Example, × 25, showing ovicell and oeciopore. B. View, × 85, showing zooecia (protoecium) and dorsal attachments. C. Another view, × 25, showing dorsal attachments of colony. (A–C after Waters, 1887.)

D. *Tubulipora flabellaris* Fabricius, 1780. An entire zoarium, magnified. (After Smitt, 1867.)

E–G. *Tubulipora serpens* (Smitt, Hincks, Busk). E. Ovicelled fossil zoarium. (After Neviani, 1905.) F. Linear branch of a zoarium. G. Ovicelled, flabelliform branch (*oc*, oeciostome). (F–G after Harmer, 1898.)

| | | |
|---|---|---|
| *Measurements.*— | Diameter of the peristome | 0.07 mm. |
| | Distance between the peristomes | 0.12 mm. |

*Affinities.*—This species differs from *Tubulipora midwayanica* in its less projecting, irregular, and incomplete fascicles. In its general aspect it much resembles *Tubulipora lucida* MacGillivray, 1884, from the Australian coasts. It differs from it in its less salient tubes and its more oblique peristomes. These are insignificant differences which a knowledge of the micrometric measurements of the Australian species might overcome.

*Occurrence.*—Middle Jacksonian: Rich Hill, 5¼ miles southeast of Knoxville, Crawford County, Georgia (very rare).

*Holotype.*—Cat. No. 65335, U.S.N.M.

## PLATONEA, new genus.

Greek: *platos*, in allusion to the ovicell occupying the entire zooecial width.

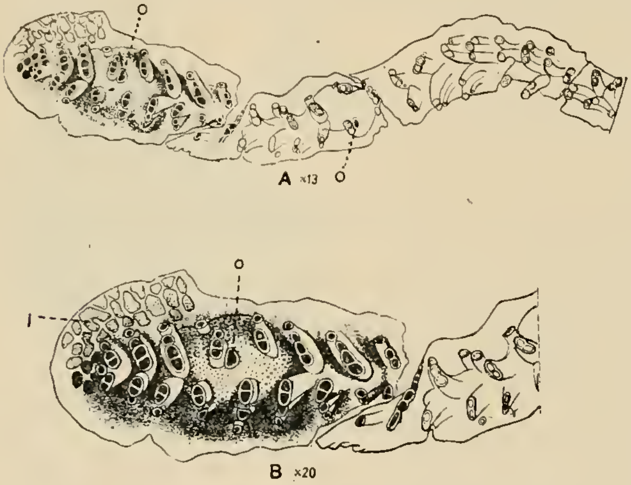

Fig. 248.—*Platonea*, new genus.

A, B. Ovicelled lobe of *Platonea* (*Reptotubigera*) *philipsae* Harmer, 1915 *o*, oeciopore.

The ovicell is subsymmetrical, lobate, median, elongate. spread out between the fascicles over the entire zoarial width. The gemmation is linear. "Oeciostome a short tube, developed on the proximal side of one of the series of zooecia, near its median end. Oeciopore directed frontally, elongated transversely and more or less oval." (Harmer, 1915.)

*Genotype.* — *Reptotubigera philippsae* Harmer, 1915.

*Range.* — Vicksburgian-Recent.

*Historical.*—The form of the zoarium is that of an incrusting *Idmonea*. Noting the great difference between this ovicell and that of *Tubulipora*, Harmer in 1915, believed that the old genus *Reptotubigera* of D'Orbigny might be restored but unfortunately all the species of *Reptotubigera* have not the same ovicell and to our great regret we can recognize the genus of the French paleontologist only for those species deprived of ovicell, in conformity with his definition and figures.

*Affinities.*—This genus differs from *Idmonea*, which has the same fascicular arrangement, in its lobate ovicell spreading between all the fascicles and not limited to a single median part of the zoarium. It differs from *Tubulipora* in its subsymmetrical ovicell, in its tubes little projecting above the ovicell, and in its linear gemmation.

*Tubulipora serpens* is provided with a zoarium like an incrusting *Idmonea*. It is not a *Platonea* because its ovicell is irregularly lobate, not subsymmetrical and because its small oeciostome is adjacent to any tube whatsoever. We repeatedly have to remark that the zoarial form is of no value for generic classification.

### PLATONEA CLAVATA, new species.

Plate 161, figs. 1, 2.

*Description.*—The zoarium incrusts shells and Orbitoid foraminifera; it is elongate, branching, with lobes in the form of a *club*. The fascicles are symmetrically arranged, alternate or opposite, uniserial, salient, little oblique. The tubes are little visible, very little convex; the peristome is thick, round or polygonal, elevated almost vertically. The ovicell is quite large, globular, spread out between the fascicles over the whole zoarial width.

| | | |
|---|---|---|
| *Measurements.*— | Diameter of the peristome | 0.10–0.14 mm. |
| | Distance between the fascicles | 0.20–0.24 mm.[1] |

Our ovicelled specimen is not an excellent one and the oeciopore is not visible.

*Affinities.*—Most of the described *Reptotubigera* have no known ovicell. Their comparison with our species is therefore absolutely useless.

*Occurrence.*—Vicksburgian (Marianna limestone): Salt Mountain, 5 miles south of Jackson, Alabama (rare).

*Cotypes.*—Cat. No. 65441, U.S.N.M.

### PLATONEA LAMELLIFERA, new species.

Plate 141, figs. 12–19.

*Description.*—The fragments of the zoarium are free, idmoneiform, very wide, short, irregular with subelliptical transverse section. The fascicles are quite salient, very close together, regular, alternated on each side of the median axis; they are formed of three to eight zooecia. The zooecia are little visible, somewhat convex; the orifice is rectangular and transverse. The basal lamella is smooth; it bears salient lamellae as wide as the zoarium, the purpose of which is to remove the latter from the substratum. The ovicell is lobate; it surrounds the fascicles more or less completely and spreads over the whole surface of the zoarium; the oeciostome is little salient and is adjacent to the first zooecium of a fascicle.

| | | |
|---|---|---|
| *Measurements.*— | Diameter of the tubes | 0.18 mm. |
| | Distance between the fascicles | 0.33 mm. |
| | Width of the fascicles | 0.18 mm. |
| | Zoarial width | 3.00 mm. |

*Variations.*—This species is idmoneiform, but the lobes are very short; they are very thick at their extremity where the incompletely calcified zooecia are visible in great number (fig. 14). Our specimens are somewhat altered; the basal lamella is theoretically smooth (fig. 18), but the tubes are often visible (figs. 17, 19) by chemical alteration.

The dorsal lamellae rested on the substratum and strengthened the zoarium which was spread out but very fragile and easily broken; their length is quite variable (fig. 18).

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[1] This is the distance between the peristomes and measured on the zoarial margins. To calculate the visible zooecial length it is necessary to add the diameter of the peristome.

The ovicell which we have discovered is not complete, but it indicates sufficiently (fig. 15) that this species is a *Platonea* and not an *Idmonea* because of the presence of the interfascicular lobes and the special position of the oeciopore.

*Affinities.*—This species differs from the recent *Tubulipora serpens* in its free and lamelliferous zoarium.

It differs from *Idmonea arcuata*, new species and *Idmonea petri* D'Archiac, 1846, in its much larger micrometric dimensions.

*Occurrence.*—Lower Jacksonian: Three and one-half miles southeast of Shell Bluff post office, Georgia (common).

*Cotypes.*—Cat. No. 65340, U.S.N.M.

### CENTRONEA, new genus.

Greek: *kentron*, center, referring to the position of the ovicell.

The ovicell is lobate, subsymmetrical, median, suborbicular. The fascicles are projecting very little above the ovicell.

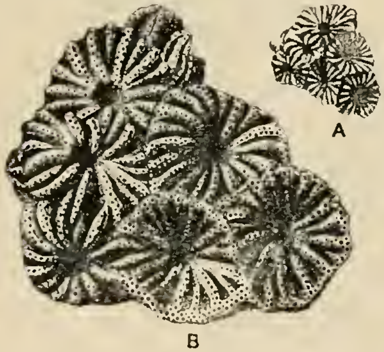

Fig. 249.—*Centronea*, new genus. A, B. Views natural size and enlarged of a composite zoarium of *Centronea* (*Multitubigera*) *micropora*, Reuss, 1869.

*Genotype.*—*Centronea* (*Multitubigera*) *micropora* Reuss, 1869. Priabonian.

As we do not know the oeciopore, the difference between this genus and *Platonea* is little important, but *Centronea* differs in the form of the ovicell, which is perhaps only in consequence of the orbicular form of the zoarium. As a contrary argument is also reasonable we prefer to recognize this genus.

Our specimens correspond exactly to the genus *Multitubigera* D'Orbigny, 1850, in their zoarial form. Following our custom we reserve this old name for the nonovicelled species. On the other hand, *Multitubigera* is formed of agglomerate subcolonies of *Actinopora*. All the known ovicelled species of *Actinopora* belong to a different family and we are therefore unable to longer employ this old term of nomenclature.

### CENTRONEA MICROPORA Reuss, 1869, variety.

Plate 135, figs. 1–15.

1869. *Multitubigera micropora* Reuss, Paläontologische Studien über die älteren Tertiarschichten der Alpen, II Abtheilung, Die fossilen Anthozoen und Bryozoen der Schichtengruppe von Crosaro, Denkschriften der k. Akademie der Wissenschaften, Wien, vol. 29, Abth. 1, pl. 34, fig. 15.

*Description.*—The zoarium is formed by the agglomeration of discoidal subcolonies superposed and joined by their germinal layer. The fascicles are salient, radiating, pluriserial, arranged around a more or less large center. The tubes are invisible; the peristomic is elevated vertically; the peristome is thin and orbicular.

*Variations.*—The zoarium is often simple and isolated (figs. 5, 6); it is a much enlarged cone, the lower part of which is ornamented with an epitheca corrugated concentrically. The germinal layer is quite large (fig. 11); it is wanting more often on the fossils, for it is very fragile. It disappears also and probably by fossilization at the junction of adjacent subcolonies (fig. 3).

When the zoarium is aggregated (fig. 3) the lower side bears as many peduncles as there are subcolonies (fig. 4). The germination of the subcolonies appears laterally (fig. 8) or almost centrally.

The fascicles bear two or three series of tubes, rarely more (fig. 12) and only on the zoarial margins.

The ovicell (fig. 14) is little salient; it is visible on account of the great reduction which it occasions in the projection of the fascicles.

The median section (fig. 15) is very instructive. In the center there are some closed zooecia (*z. c.*). The gemmation is habitual and the tubes grow one from another from their dorsal according to the usual law (right side of fig. 15). The young subcolonies appear to come from the superior ramification and not the dorsal of a tube (left of fig. 15).

*Affinities.*—Our specimens are not exactly identical with the Reuss figures. The fascicles appear shorter and more irregular, and we believe it useful to consider them as a variety until comparisons can be made with typical specimens of each. Neither Waters nor ourselves have yet been fortunate enough to discover Reuss's species in the material from Vicentin.

*Occurrence.*—Middle Jacksonian (Castle Hayne limestone): Wilmington, North Carolina (very common).

*Geological distribution.*—Priabonian of the Vicentin (Reuss).

*Plesiotypes.*—Cat. No. 65343, U.S.N.M.

### MESONEA, new genus.

Greek: *mesos*, median.

The ovicell is lobate, median, subsymmetrical. The oeciostome curves over and turns downward. There are curious, lateral, porous windows. The basal surface is ornamented with tergopores. The fascicles are arranged symmetrically on each side of the zoarial axis. Eight tentacles.

*Genotype.*—*Mesonea* (*Retepora*) *radians* Lamarck, 1816.

*Range.*—Priabonian-Recent.

Harmer in 1915 held that *Retepora radians* was the type of the genus *Crisina* D'Orbigny, 1850. The French paleontologist applied this term to species of *Idmonea* having a porous, basal lamella, but *Crisina normaniana* D'Orbigny, 1812, the first described species of the genus, shows the ovicell and we have adopted it as the genotype. For Lamarck's species we create the genus *Mesonea*, which differs from *Idmonea* in the presence of tergopores, in the ovicell which spreads entirely between the fascicles, and in the lateral porous windows.

### ERKOSONEA, new genus.

Greek: *erkos*, partition in allusion to the ornamentation of the dorsal.

The zoarium is idmoneiform. The dorsal bears dactylethrae, which appear also on the frontal at the bifurcations. The ovicell is globular, spread out between three fascicles over the width of the zoarium.

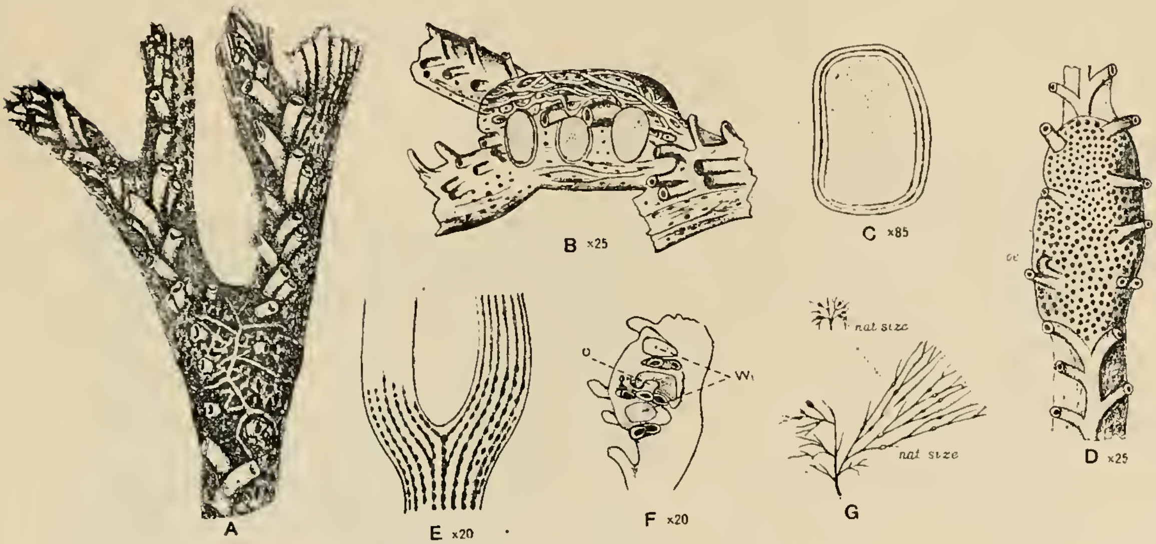

Fig. 250.—*Mesonea*, new genus.

A–G. *Mesonea* (*Retepora*) *radians* Lamarck, 1816. A. Ovicelled zoarium, anterior face. (After MacGillivray, 1880.) B. Ovicell, × 25, seen in profile and showing the porous windows. C. Transverse section of the ovicell, × 85. (After Waters, 1887.) D. Ovicell with the oeciostome (*oe*), × 25. (After Waters, 1914.) E. Dorsal, × 20. F. Sketch showing details of ovicell (*o*), and porous windows (*w*), × 20. (After Harmer, 1915.) G. Zoarium, natural size. (After Waters, 1914.)

*Genotype.—Erkosonea semota*, new species, Jacksonian.

The dactylethrae are the aborted tubes, since they are closed by a calcareous membrane and do not contain a polypide. They have the same diameter as the ordinary tubes and grow in the vicinity of the base of the lower tubes (and not at different heights as the tergopores); they become branched but rarely.

These dactylethrae characterize the family Clausidae D'Orbigny, 1853, but Gregory noted no idmoneiform genus.

*Tubulipora campicheana* Waters, 1887, of which the ovicell is known, must be put in a genus close to *Erkosonea*. The ovicell is very close to that of *Mesonea*. *Erkosonea* differs from that genus in the presence of dactylethrae instead of tergopores.

#### ERKOSONEA SEMOTA, new species.

Plate 133, figs. 1–13.

*Description.*—The zoarium is idmoneiform, linear, bifurcated, with oval transverse section. The fascicles are quite salient, *scattered*. Formed of five zooecia, they border the zoarial margins and are almost opposite on each side of the median crest. The tubes are visible convex, separated by a slight salient thread; the peristome is thin, round or rectangular. The dorsal is hardly convex; it is formed by a thick layer of dactylethrae closed by a thin calcareous lamella. The dactylethrae appear on the frontal at the bifurcations.

| | | |
|---|---|---|
| *Measurements.*— | Diameter of the tubes | 0.16–0.20 (maximum 0.30 mm.). |
| | Distance between the fascicles | 0.80–1.00 mm. |
| | Width of the fascicles | 0.24 mm. |
| | Width of the branches | 1.20 mm. |

*Variations.*—This species is quite fragile; the fascicles are very often broken and the dactylethrae have lost their covering pellicle. Specimens like figure 6 are much more frequent than the good specimens (figs. 2, 3).

In longitudinal section the walls of the dactylethrae (fig. 9) often appear hollow; the intercellular tissue is therefore incomplete. The nature of dactylethrae is easy to see on our figures, but their function is unknown to us. We have not had the fortune to find the growing extremity of a branch near the zoarial base.

The tangential section of the tubes is analogous to that of all other Cyclostomata.

*Affinities.*—The species differs from *Erkosonea admota* in the great distance between the fascicles and in the absence of radicular lamellae on the dorsal.

*Occurrence.*—Lower Jacksonian (Moodys marl): Jackson, Mississippi (common).

*Cotypes.*—Cat. No. 65364, U.S.N.M.

### ERKOSONEA ADMOTA, new species.

Plate 139, figs. 14–22; plate 133, fig. 8.

*Description.*—The branches of the zoarium are large, linear, bifurcated with oval transverse section. The fascicles are salient, *close together*, oblique, divergent, formed of five zooecia; they are arranged alternately on each side of the median crest and do not spread beyond the zoarial margins. The tubes are visible, very little convex; the peristome is thin and rectangular. On the dorsal the dactylethrae have very salient margins; there are wide radicular lamellae.

| | | |
|---|---|---|
| *Measurements.*— | Diameter of the tubes | 0.20 mm. |
| | Distance between the fascicles | 0.50–0.60 mm. |
| | Width of the fascicles | 0.20 mm. |
| | Width of the branches | 1.5 mm. |

The dorsal is hardly convex; it frequently bears very wide radicular lamellae. These are formed of two rows of dactylethrae which bend around at right angles. In *Idmonea grallator* there are the habitual branchings of the tubes which form the radicells. The remarkable facility with which the Cyclostomata modify their tubes for adaptation proves that the zoarium is not only an animal colony but a veritable real individuality. The vital unity is assured in the interior of the zooecia by the mesenchymatous tissue.

*Affinities.*—This species differs from *Erkosonea semota* in the lesser distance of the fascicles from each other and in the presence of the radicular lamellae.

*Occurrence.*—Middle Jacksonian: Wilmington, North Carolina (very common); near Lenuds Ferry, South Carolina (rare); Eutaw Springs, South Carolina (rare).

Upper Jacksonian (Ocala limestone): West bank Sepulga River, Escambia County, Alabama (rare).

*Cotypes.*—Cat. No. 65357, U.S.N.M.

## PLEURONEA, new genus.

Greek: *pleuron*, side, referring to the position of the ovicell.

The ovicell is situated laterally on one-half of the basal lamella and between the fascicles on a single side of the median axis. The oeciopore appears to be the first tube of a fascicle. The basal surface is provided with large tergopores generally imperfectly oriented. The zooecia are grouped in fascicles, arranged symmetrically on each side of the zoarial axis.

*Genotype.*—*Idmonea fenestrata* Busk, 1859.

*Range.*—Midwayan-Astian.

This genus differs from *Mesonea* not only in the lateral position of the ovicell but also in the nature of the canals which reinforce the basal lamella. If one can generalize Busk's figure, 1859, these canals would be closed at their extremity by a calcareous, porous lamella extremely fine and fragile.

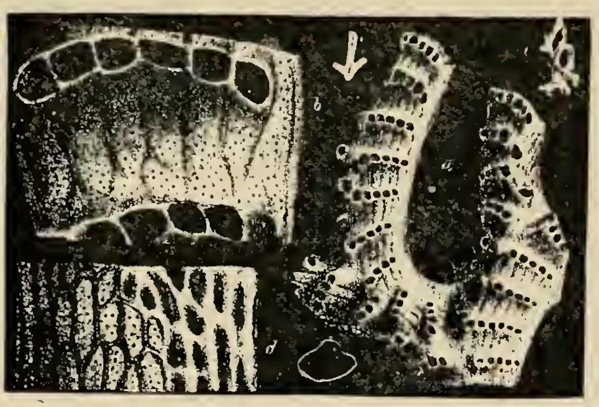

FIG. 251.—*Pleuronea*, new genus.

Views of *Pleuronea (Idmonea) fenestrata* Busk, 1859, from the Crag of England, showing the zoarium natural size, the frontal side enlarged, cross section of a branch and the frontal and dorsal sides much enlarged. (After Busk, 1859.)

### PLEURONEA FIBROSA, new species.

Plate 107, figs. 2–9.

*Description.*—The zoarium is free, idmoneiform, bifurcated, with oval cross section. The fascicles are salient, uniserial, crowded and formed of five tubes at the maximum. The tubes have a visible peristomie; the peristome is round or rectangular. The basal lamella bears a thick layer of tergopores, the orifices of which are irregular but arranged longitudinally and give a *fibrous* aspect to the zoarium. The ovicell is globular, salient, porous.

| *Measurements.*— | | |
|---|---|---|
| | Peristome | 0.10 mm. |
| | Distance between the fascicles | 0.20 mm. |

*Affinities.*—The ovicelled specimen (fig. 4) bears two ovicells symmetrically placed to the right and left of the zoarium.

This species differs from *Pleuronea alveolata* in the fibrous aspect of the basal lamella and in the different position of the ovicell.

It differs from *Pleuronea* (*Idmonea*) *fenestrata* Busk. 1859, in its much smaller tergopores and its smaller micrometric measurements.

*Occurrence.*—Midwayan (Clayton limestone): Luverne, Crenshaw County, Alabama (common).

*Cotypes.*—Cat. No. 65244, U.S.N.M.

### PLEURONEA FENESTRATA Busk, 1859.

Plate 114, figs. 1-18.

1859. *Idmonea fenestrata* Busk, A Monograph of the Fossil Polyzoa of the Crag, Publications of the Palaeontographical Society of London, vol. 14, p. 105, pl. 15, fig. 6.

1877. *Idmonea fenestrata* Manzoni, I Briozoi fossili del Miocene d'Austria ed Ungheria; Part 3, Denkschriften der math. natur. Classe der k. Akademie der Wissenschaften Wien, vol. 38, Abth. 2, p. 6, pl. 4, fig. 14.

1880. *Idmonea fenestrata* Seguenza, Le formazioni terziarie nella Provincia di Reggio (Calabria), Reale Accademie dei Lincei, Memoire della Classe di Scienze Fisiche matematiche e Naturali, Roma, ser. 3, vol. 6, p. 132.

1897. *Idmonea fenestrata* Neviani, Corallari e Briozoi neogenici di Sardegna, Bolletino dell Societa Geologica Italiana, Roma, vol. 15, p. 595 (27).

*Description.*—The zoarium is free, arborescent, bifurcated or reticulated with oval section, idmoneiform. The fascicles are quite salient, uniserial, scattered, alternate, adjacent to the median crest. They bear at the maximum five tubes. The tubes are salient, visible exteriorly, flat, separated by a salient thread; the peristome is thin and rectangular. The basal lamella bears a thick layer of tergopores almost as large as the tubes; their orifice forms regular, longitudinal lines or a complicated network. The ovicell is large, convex, porous; it bears tuberosities arranged in quincunx.

| | | |
|---|---|---|
| *Measurements.*— | Peristome | 0.12 mm. |
| | Distance between the fascicles | 0.24–0.30 mm. |

*Variations.*—The basal side of this species is quite variable; there is not a single specimen exactly like the others. The orifices of the tergopores are large (fig. 4) or small (figs. 5, 7, 13) in quincunx or in lines; they even overturn the frontal on the old zoaria (figs. 12, 16); those which are arranged in longitudinal series are the most frequent. The tergopores sometimes occur at the base of pseudosulci.

Fortunately the frontal is more regular (figs. 3, 14) and permits the determination more easily.

The ovicell of this species is quite variable in its form, dimensions, and position. In our studies on the cyclostomatous bryozoa we figure some interesting variations which show that the ovicell is as polymorphic as in the genus *Tubulipora* itself.

The longitudinal section (fig. 18) shows us larger and less entangled tergopores than in *Pleuronea alveolata;* they are also longer and more oblique.

*Affinities.*—When the tergopores are arranged in longitudinal series this species presents the aspect of *Pleuronea fibrosa;* but it is distinguished from it by its much larger orifice and the greater separation of the fascicles.

It differs from *Pleuronea alveolata* in the greater separation of the fascicles and in the different position of the ovicell, and from *Idmonea reticulata* Reuss, 1869, in the very different form of the orifice of the tergopores.

*Occurrence.*—Claibornian (Gosport sand): One mile south of Rockville, Clarke County, Alabama (rare).

Lower Jacksonian (Moodys marl): Jackson, Mississippi (very common).

Middle Jacksonian: One-half mile southeast of Georgia Kaolin Company's mine, Twiggs County, Georgia (rare); 12 miles southeast of Marshallville, Georgia (rare); Baldock, Barnwell County, South Carolina (very rare).

Jacksonian (Zeuglodon zone): Bluff on south side of Suck Creek, Clarke County, Mississippi; Shubuta, Mississippi (common).

Vicksburgian (Marianna limestone): Salt Mountain, 5 miles south of Jackson, Alabama (rare); Vicksburg, Mississippi (rare); Murder Creek, east of Castlebury, Conecuh County, Alabama (very rare).

*Geological distribution.*—Helvetian of Italy (Neviani); Tortonian of Austria-Hungary (Manzoni) and Italy (Neviani); Astian of England (Busk).

*Plesiotypes.*—Cat. Nos. 65266, 65267, U.S.N.M.

### PLEURONEA SUBPERTUSA, new species.

Plate 113, figs. 6–15.

*Description.*—The zoarium is free, branched, with suborbicular section, idmoneiform. The fascicles are quite oblique, opposite, and reunite on the zoarial axis. The tubes are salient, with the maximum number of six to a fascicle; they are flat and are separated by a salient thread. The basal lamella bears tergopores, the diameter of which is perceptibly equal to that of the tubes.

| *Measurements.*— | | |
|---|---|---|
| | Diameter of the peristomes | 0.10 mm. |
| | Distance between the fascicles | 0.20–0.28 mm. |

*Variations.*—The species is rarely well preserved; it must have frequented violent currents or agitated waters. The basal lamella with its tergopores is easily detached from the anterior portion of the zoarium (fig 10).

The tergopores are deprived of polypide; their diameter is that of the tubes. They grow on the dorsal of the tubes in variable number; they diverge at first superiorly and then curve abruptly perpendicularly to the zoarial axis, thus forming a right angle (fig. 15). Their walls are thickened, a fact which is perfectly visible in tangential sections (fig. 12); they are orbicular in the interior and polygonal at the exterior.

Each tergopore has only one point of tangency with each of the other tergopores which surround it. The interstices between the nonadjacent walls are rarely calcified (fig. 12); they are generally empty and appear white in tangential (fig. 11) and longitudinal sections (fig. 15). The interstices disappear when the section passes rigorously through the point of tangency (fig. 15).

The function of the tergopores is evidently zoarial, but we are totally ignorant of their nature.

*Affinities.*—This species much resembles *Idmonea pertusa* Reuss, 1847, in its basal lamella, and in the fossils, it is difficult to separate them. It differs from it in its frontal, the fascicles of which are close together and not spread out from the median line.

It differs from *Idmonea reticulata* Reuss, 1869, in the very different nature of its tergopores, and from *Pleuronea fusiformis* in the exterior polygonal form of its tergopores and in their larger diameter.

*Occurrence.*—Claibornian (Gosport sand): One mile southwest of Rockville, Clarke County, Alabama (rare).

Lower Jacksonian (Moodys marl): Jackson, Mississippi (common).

Middle Jacksonian: Rich Hill 5¼ miles southeast of Knoxville, Crawford County, Georgia (very rare).

Upper Jacksonian (Ocala limestone): Old Factory, about 1½ miles above Bainbridge, Georgia (very rare).

Vicksburgian (Red Bluff clay): One-quarter mile west of Woodwards, Wayne County, Mississippi (rare).

Vicksburgian (Marianna limestone): Vicksburg, Mississippi (lower bed, rare).

*Cotypes.*—Cat. No. 65432, U.S.N.M.

### PLEURONEA FUSIFORMIS, new species.

Plate 161, figs. 3, 4.

*Description.*—The zoarium is free, bifurcated, idmoneiform. The bundles are salient, transverse, alternate on each side of the median axis, and formed of four to five zooecia. The tubes are little visible; the orifice is rectangular and the peristome is thin. The basal lamella is convex and bears *fusiform* tergopores. The ovicell is large, globular, salient; the oeciostome is adjacent to a bundle and subterminal.

*Measurements.*—

| | |
|---|---|
| Distance between the fascicles | 0.36 mm. |
| Width of the fascicles | 0.10 mm. |
| Zoarial width | 0.50–0.60 mm. |
| Dimensions of the tergopores | 0.04–0.08 mm. |

*Affinities.*—This species is the American representative of *Idmonea reticulata* Reuss, 1869, of the Priabonian of the Vicentin. It differs from it, however, in the more elongated form of the tergopores.

*Occurrence.*—Vicksburgian (Marianna limestone): Salt Mountain, 5 miles south of Jackson, Alabama (very rare).

*Holotype.*—Cat. No. 65442, U.S.N.M.

### PLEURONEA ALVEOLATA, new species.

Plate 107, figs. 10–18.

*Description.*—The zoarium is free, arborescent, bifurcated, idmoneiform with subcircular section. The fascicles are salient, opposite, crowded, and formed of five or six tubes at the maximum. The tubes have their upper portion visible and are separated by a salient line; the peristome is thin and rectangular. The basal lamella is ornamented with large tergopores with orifices more or less funnel-shaped, giving them the aspect of *alveolae.*

*Measurements.*—

| | |
|---|---|
| Diameter of the peristome | 0.12 mm. |
| Distance between the fascicles | 0.20–0.30 mm. |

The tergopores are confused in every sense of the word; no section can cut through their whole length, and they appear as an irregular network with large meshes (fig. 16). They are polygonal exteriorly (figs. 12, 17). Their walls are not thick (fig. 17) and the interstices left between them are filled with a compact calcareous deposit. They are attached to the lamella and appear to be dorsal ramifications of the zooecia.

*Affinities.*—The species differs from *Pleuronea fibrosa* and *Pleuronea fenestrata* in the very special funnel-shaped form of the orifice of the tergopores.

*Occurrence.*—Midwayan (Clayton limestone): Mabelville near Little Rock, Arkansas (very common); 1 mile west of Fort Gaines, Georgia (common).

*Cotypes.*—Cat. No. 65245, U.S.N.M.

### TRETONEA, new genus.

Greek: *treton*, opening, in allusion to the ovicells which are pierced by the fascicles.

The ovicell is lobate, subsymmetrical, median, elongated between the fascicles. There are pores on both faces of the zoarium. The fascicles are arranged symmetrically on each side of the median axis. The oeciostome is placed at the beginning of a fascicle.

*Genotype.—Tretonea levis*, new species. Lower Jacksonian.

The nature of the pores is not known for the specimens were silicified and it has not been possible to make sections.

### TRETONEA LEVIS, new species.

Plate 141, figs. 20–27.

*Description.*—The zoarium is free, branched, with triangular sections; it bears special pores on both sides. The fascicles are salient, quite close together, formed of six to eight zooecia. The tubes are invisible and hidden under the pores; the peristome is rectangular, thin and salient. The ovicell is *smooth;* the oeciostome commences the second fascicle; it is a little larger than the apertures and turned in the direction of the median axis.

| | | |
|---|---|---|
| *Measurements.*— | Distance between the fascicles | 0.17 mm. |
| | Width of the fascicles | 0.11 mm. |
| | Diameter of the peristomes | 0.12 mm. |
| | Maximum zoarial width | 1.8 mm. |

*Affinities.*—This species much resembles *Retecava*, in the arrangement of its pores. but differs in the nature of its ovicell, which is entirely frontal and not located on a single side of the zoarium.

The knowledge of the nature of the pores and of better ovicells will perhaps permit of the discovery some day of the true position of this species.

This species differs from *Idmonea subcancellata* Manzoni, 1877, in its fascicles, which are much more salient and formed of more than three to four tubes.

*Occurrence.*—Lower Jacksonian: Three and one-half miles southeast of Shell Bluff post office, Georgia (rare.)

*Cotypes.*—Cat. No. 65341, U.S.N.M.

### Genus IDMONEA Lamouroux, 1821.

1821. *Idmonea* Lamouroux, Exposition Methodique des Polypiers, p. 80.

The ovicell is irregular, little lobed or not at all, subsymmetrical, placed on the median crest of the zoarium. The fascicles are not entirely enveloped by the ovicell. The oeciostome is excentric, nonterminal, and replaces the first or the second tube of a fascicle. The basal lamella is simple and bears no pores.

*Accepted genotype.*—*Idmonea atlantica* Johnson, 1847.

*Range.*—Senonian-Recent.

This genus differs from *Tubulipora* Lamarck, 1816, in the absence of well-developed lobes, and in its oeciostome nonsubcentral, and occupying a fixed place among the fascicles.

*Historical.*—The genus *Idmonea* was founded by Lamouroux upon *I. triquetra*, an incrusting form found in the Bathonian at Ranville, France. The history of the genus has been given many times, but the greatest confusion has existed among paleontologists as to its interpretation. Among the zoologists. however. the name *Idmonea* has always been applied to the well-known zoarial form bearing an anterior ovicell. Former authors were ignorant of the importance of the ovicell and even of its existence. All speculation on their work is absolutely useless and idle. Usage and the principle of least change seems to us the only considerations to be regarded, and we have therefore followed the zoologist in regarding *Idmonea atlantica* Johnston, 1847, as the accepted genotype.

*Determination.*—The determination of species of *Idmonea* is very difficult in spite of the introduction, due to Pergens, of the micrometric dimensions; this is in reality because we have only isolated fragments for study. If the ovicell in rapport with the number of larvae and the fissiparity of the primary embryo is quite variable in form and position, the oeciostome is more constant, for it is only in rapport with the form and size of the larvae. But the larvae of the different families of Cyclostomata are much alike. It is necessary, therefore, to seek another character which would permit us to complete our knowledge of their biological tendencies. This character is furnished us precisely in the study of the base of the zoarium and in its mode of attachment to the substratum. This manifestation of the ancestrular zooecia issued directly from the larvae is most important and it will be necessary in the future to introduce it in descriptions.

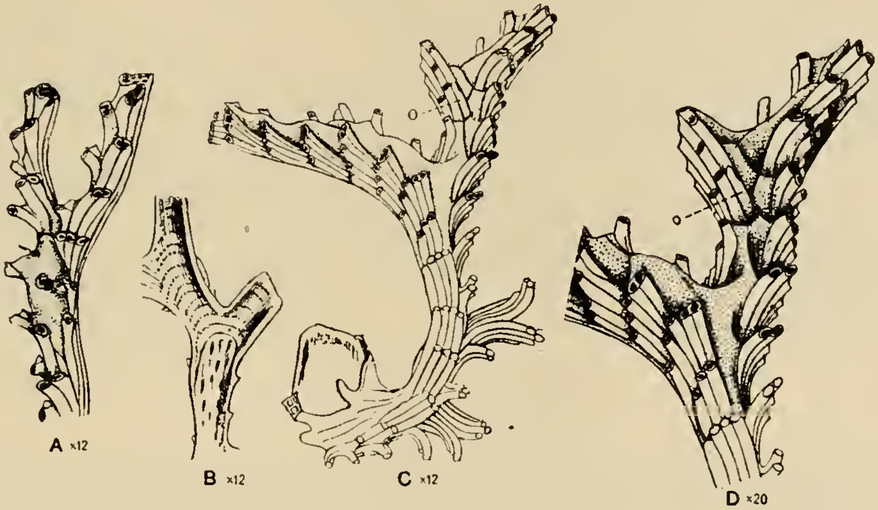

FIG. 252.—Genus *Idmonea* Lamouroux, 1821.

A–D. *Idmonea atlantica* Forbes. A. Anterior face of the zoarium, × 12. B. Posterior face basal lamella), × 12. C. Base of the zoarium, × 12. D. Ovicell and its oeciostome (*o*), × 20. (After Harmer, 1915.)

Species of *Idmonea* are often attached by an expanded base. The branches are bushy with their dorsal turned toward the exterior. Very often the branches are horizontal and parallel to the substratum, but this is a dangerous situation on account of their fragility and liability to fracture. Certain species remedy this by the addition of canals of reinforcement or firmatopores. Other species develop on their dorsal, appendages of more or less length of a kind of calcareous radicell, more numerous on the branches of the base, which strengthen the whole zoarial system. Although the word "radicell" is not very appropriate, we have not thought it necessary to coin a new name in order to designate these structures.

The same species of *Idmonea* often presents very different and unexpected aspects which would lead one to believe in the existence of many species. The micrometric measurements are in themselves insufficient. We have recourse to two methods of identification and comparison—the transverse section and the comparison of photographs enlarged upon the same scale.

### IDMONEA TACTA, new species.

Plate 107, figs. 19–24.

*Description.*—The zoarium is somewhat claviform, bifurcated, and much compressed. The fascicles are salient, *crowded*, and formed of two to seven zooecia;

they are alternated on each side of the median line and *adjacent* to each other on this line. The tubes are visible, flat, separated by a scarcely salient thread. The basal lamella is striated transversally; the zoarial margins are thick and distinct.

*Measurements.*—

| | |
|---|---|
| Diameter of the tubes | 0.06 mm. |
| Distance between the fascicles | 0.12–0.20 mm. |
| Width of the fascicles | 0.10 mm. |
| Width of the zoarium | 0.8 mm. |

*Affinities.*—In the number of the tubes to the fascicles this species approaches *Idmonea arcuata;* it differs from it in the separation of the fascicles which is less than 0.20 mm. and in the rectilinear form of its zoarium.

In the zoarial margins of the basal lamellae the species resembles *Idmonea petri* D'Archiac, 1846, but differs from it in the ensemble of its much smaller micrometric dimensions and in its claviform zoarium.

*Occurrence.*—Midwayan (Clayton limestone): One mile west of Fort Gaines, Georgia (rare).

*Cotypes.*—Cat. No. 65246, U.S.N.M.

### IDMONEA MAGNA, new species.

Plate 137, figs. 1–18.

*Description.*—The zoarium is *large*, dichotomously branched, sometimes reticulated, enlarged at the bifurcations, triangular, higher than wide in transverse section. The fascicles are quite salient, oblique, alternated on each side of the median crest and quite distant from it; they bear four to eight zooecia. The tubes are visible, convex, almost all equal. The basal lamella is striated transversally, flat, somewhat convex or a little concave; the tubes are often visible; the zoarial margins are very narrow and somewhat thickened.

*Measurements.*—

| | |
|---|---|
| Diameter of the tubes | 0.34 mm. |
| Distance between the fascicles | 0.70 mm. (0.40–0.80 mm.). |
| Width of fascicles | 0.24–0.30 mm. |
| Zoarial width | 1.40–2.00 mm. |

*Variations.*—The number of the tubes to the fascicle is more often four or five (figs. 2, 3); at the bifurcations it is larger (eight) (fig. 9). The basal lamella is convex (fig. 5) or concave (fig. 10); the two forms are visible on the same fragment (fig. 8). The fascicles of the reticulated branches are closer (fig. 4). At the bifurcations the fascicles are transverse (fig. 2), if the branches rest in the same plane; when the branches are twisted and are opposite, the fascicles remain distinct and alternate (fig. 9). On well-preserved specimens the tubes are visible on the basal lamella (fig. 6). The incomplete zooecia in the process of formation are quite numerous (fig. 10) and give a very crowded appearance.

In transverse section (fig. 18) the zoarium is triangular and the zooecia are polygonal; but seen from the interior, by abrasion of the basal lamella, they are round (fig. 15). The longitudinal section (fig. 11) is normal; the tubes grow from the basal lamella and branch almost immediately (fig. 12). The zooecial walls appear hollow (fig. 13); there are small diaphragms visible here and there.

On account of its size this species is easy to determine. It characterizes the Jacksonian in America.

*Occurrence.*—Middle Jacksonian: Rich Hill, 5½ miles southeast of Knoxville, Crawford County, Georgia (very common); one-half mile southeast of Georgia Kaolin Co. mine, Twiggs County, Georgia (common): 12 miles southeast of Marshallville, Georgia (very common); Eutaw Springs, South Carolina (very rare); Baldock, Barnwell County, South Carolina (rare); 17 miles northeast of Hawkinsville, Georgia (common); 3¼ miles south of Perry, Georgia (very common); 3½ miles north of Grovania, Georgia (very common); 1½ miles southeast of Lily, Dooly County, Georgia (very rare).

Jacksonian (Zeuglodon zone): Shubuta, Mississippi (rare).

Upper Jacksonian (Ocala limestone): West bank Sepulga River, Escambia County, Alabama (common).

Lower Jacksonian (Moodys marl): Jackson, Mississippi (common).

*Cotypes.*—Cat. Nos. 65346–65350, U.S.N.M.

### IDMONEA MILNEANA D'Orbigny, 1839.

Plate 136, figs. 1–12.

1839. *Idmonea milneana* D'ORBIGNY, Voyage dans l'Amérique méridionale, vol. 5, pt. 4, p. 20, pl. 9, figs. 17–21.

1850–1852. *Idmonea milneana* D'ORBIGNY, Paleontologie française, Terrain Crétacé, vol. 5, Bryozoaires, p. 732.

1860. *Idmonea milneana* BUSK, Note on the fossil Polyzoa collected near Mount Gambier, South Australia, Quarterly Journal Geological Society, London, vol. 16, p. 261.

1864. *Idmonea milneana* STOLICZKA, Fossile Bryozoen aus dem Tertiären Grünsandsteine der Orakei-Bay bei Aukland, Reise der Oest. Fregatte *Novara*, geologischer Theil, vol. 1, Abth. 2, Paleontologie, p. 114.

1872. *Idmonea milneana* SMITT, Floridan Bryozoa, Kongl. Svenska Vetenskaps-Akad. Handl., p. 8, pl. 3, figs. 14–17.

1875. *Idmonea milneana* BUSK, Catalogue of marine Polyzoa in the collection of the British Museum, pt. 3, Cyclostomata, p. 12 .

1877. *Idmonea milneana* ETHERIDGE, Synopsis of the known species of Australian Tertiary Polyzoa, Journal Royal Society New South Wales, vol. 11, p. 13.

1881. *Idmonea milneana* RIDLEY, Account of the zoological collections made during the Survey of H. M. S. *Alert* in the Straits of Magellan and on the coast of Patagonia, Polyzoa, Proceedings of Zoological Society of London, p. 56.

1882 *Idmonea milneana* HASWELL, On the Cyclostomatous Polyzoa of Port Jackson and neighborhood, Proceedings of Linnean Society, New South Wales, vol. 4, p. 351.

1882. *Idmonea milneana* MCCOY, Bryozoa in McCoy's Prodromus of the Zoology of Victoria, vol. 1, dec. 7, p. 29, pl. 68, fig. 1.

1884. *Idmonea milneana* WATERS, On fossil Cyclostomatous Bryozoa from Australia, Quarterly Journal of the Geological Society, London, vol. 40, p. 684.

1884. *Idmonea milneana* BUSK, Report on the Polyzoa collected by H. M. S. *Challenger*, pt. 1, p. 13.

1887. *Idmonea milneana* MACGILLIVRAY, Catalogue of the Marine Polyzoa of Victoria, Transactions and Proceedings of the Royal Society of Victoria, vol. 23, p. 287.

1887. *Idmonea milneana* Waters, Bryozoa from New South Wales, Annals Magazine Natural History, ser. 5, vol. 20, p. 256.

1888. *Idmonea milneana* Waters, On some ovicells of Cyclostomatous Bryozoa, Journal Linnean Society, London, Zoology, vol. 20, p. 279, pl. 14, fig. 8.

1889. *Idmonea milneana* Jelly, A Synonymic Catalogue of the Recent Marine Bryozoa, p. 118.

1890. *Idmonea milneana* Ortmann, Die Japanische Bryozoen-Fauna, Archiv. fur Naturgeschichte, vol. 1, Heft 1, p. 59, pl. 4, fig. 21.

1905. *Idmonea milneana* Waters, Bryozoa from near Cape Horn, Journal Linnean Society, London, vol. 29, p. 249 (habitat).

1908. *Idmonea milneana* Canu, Bryozoaries fossiles du Sud-Ouest de la France. Bulletin Société géologique France, ser. 4, vol. 8, p. 386, pl. 7, fig. 16.

1909. *Idmonea milneana* Canu, Bryozoaires tertiares des environs de Paris, Annals de Paleontologie, p. 125 (53), pl. 14, figs. 11, 12, 13. (Paleontologic bibliography).

1910. *Idmonea milneana* Canu, Bryozoaires fossiles du Sud-Ouest de la France, Bulletin Société géologique de France, ser. 9, vol. 10, pl. 840.

1911. *Idmonea milneana* Canu, Bryozoaires fossiles de Sud-Ouest de la France, Bulletin de la Société géologique, ser. 4. vol. 11, p. 451, text. fig. 6. (ind.).

1914. *Idmonea milneana* Waters, The marine fauna of East Africa and Zanzibar, Proceedings of the Zoological Society of London, p. 844.

*Description.*—The zoarium is bifurcated, compressed with elliptical transverse section broader than high. The fascicles are scattered, little salient, arranged alternately on each side of the median axis; they are formed of three zooecia, the first of which is isolated. The tubes are visible, convex, with thin peristome. The basal lamella is convex, more or less striated transversally; the tubes are visible longitudinally.

*Measurements.*— {Diameter of the tubes---------------------- 0.16–0.20 mm.
Distance between the fascicles--------------- 0.40–0.60 mm.

*Variations.*—This species is rather constant in its characters and its determination is easy. We have not had the chance to discover its ovicell, but this has been figured by Waters and Smitt; it must probably occur very rarely.

The width of the zoarium varies between 0.80 mm. (fig. 4) and 1.33 mm. (fig. 3). The striations of the basal lamella are generally little deep; rarely they are accentuated (fig. 5).

The dorsal tangential section reveals the spindles characteristic of all the cyclostomatous bryozoa in which the basal lamella is not reinforced (fig. 12). The microscopic structure of the tubes is identical on the basal lamella (fig. 9) and on the frontal face (fig. 8). The basal lamella has therefore no particular reality; it results simply from the agglomeration of the tubes which are closely united together.

*Occurrence.*—Middle Jacksonian (Castle Hayne limestone): Wilmington, North Carolina (very common).

Vicksburgian (Red Bluff clay): One-fourth mile west of Woodwards, Wayne County, Mississippi (very rare).

*Geological distribution.*—Ypresian of England (Gregory); Lutetian of the Paris Basin (Gregory, Canu), of the Bordeaux Basin (Canu), of the French Pyrenees

(Canu); Auversian of the Pyrenees (Canu); Latdorfian of Germany (Stoliczka); Rupelian (=Stampian) of Germany (Schreiber); Tortonian of Austria-Hungary (Manzoni); Sicilian of Italy (Seguenza, Neviani); Quaternary of Italy (Seguenza-Neviani); Miocene of New Zealand (Stoliczka) and of Australia (Waters, MacGillivray).

*Habitat.*—Mediterranean. Indian Ocean: Zanzibar (16 meters). Antarctic Ocean: Terre del Fuego, Patagonia (13-48 meters), Kerguelen Island (122-244 meters. Atlantic Ocean: Azores (733 meters), Chonos Archipelago, Florida (36–609 meters). Pacific Ocean: Fiji Islands, Queen Charlotte Islands, Australia.

*Plesiotypes.*—Cat. No. 65351, U.S.N.M.

### IDMONEA ARCUATA, new species.

Plate 135, figs. 16–20.

*Description.*—The zoarium is short, free, *arched*, lobate, with transverse section wide and elliptical. The fascicles are quite salient, regular, arranged alternately on each side of the median axis; they are formed of six to eight zooecia. The tubes are little visible, small, nearly equal on the same fascicles; the peristome is rectangular. The basal lamella is smooth with the convex striations rather widely spaced.

*Measurements.*—

| | |
|---|---|
| Diameter of the tubes | 0.10 mm. |
| Distance between the fascicles | 0.24–0.28 mm. |
| Width of the fascicles | 0.12–0.14 mm. |
| Width of the zoarium | 1.6 mm. |

We have not discovered the ovicell of this charming species; we are therefore not certain of its generic classification other than certain lobes are claviform, a condition which does not exist in the typical *Idmonea*. Moreover, our specimen from Lenuds Ferry is incrusting a bryozoan.

*Affinities.*—This species differs from *Idmonea petri* D'Archiac, 1846, in the lesser distance between the fascicles (0.28 and not 0.40 mm.) in its smaller tubes and the absence of the rectilinear form of the zoarium, and in a larger number of tubes (eight) to the fascicle.

It much resembles *Idmonea tacta* in its micrometric measurements, but differs from it in a greater interfascicular distance (0.24 and not 0.20 mm.), in a greater number of tubes to the fascicles (eight and not six), and in its nonlinear zoarium.

*Occurrence.*—Middle Jacksonian: Wilmington, North Carolina (rare); near Lenuds Ferry, South Carolina (very rare).

*Cotypes.*—Cat. No. 65344, U.S.N.M.

### IDMONEA SLOANI, new species.

Plate 135, figs. 21–26.

*Description.*—The zoarium is free, linear, bifurcated, with triangular transverse section which is higher than wide. The fascicles are salient, close together, arranged alternately on each side of a median crest; they contain four or five zooecia, the first of which is adjacent to the neighboring fascicles and placed on the median axis. The tubes are small, distinct, separated by a salient thread. The basal lamella is slightly ornamented with convex striations; it is flat or concave and bordered by a more or less wide and thickened margin.

| | | |
|---|---|---|
| *Measurements.*— | Diameter of the tubes | 0.10 mm. |
| | Distance between the fascicles | 0.20 mm. |
| | Width of the fascicles | 0.10 mm. |

*Affinities.*—This species contains sometimes on the dorsal traces of firmatopores. It is very close to *Idmonea taeta* in its small dimensions and the union of the fascicles on the median crest, but it differs in that the number of tubes is always greater than five. It differs from *Idmonea petri* D'Archiac, 1846, in its smaller zoarial dimensions and the much smaller distance (0.20 and not 0.40 mm.) between the fascicles.

We dedicate this charming and delicate species to Mr. Earle Sloan of Charleston, South Carolina, in appreciation of his excellent work upon the geology of his State.

*Occurrence.*—Middle Jacksonian: Wilmington, North Carolina (very rare); near Lenuds Ferry, South Carolina (common).

*Cotypes.*—Cat. Nos. 65345, 65480, U.S.N.M.

### **IDMONEA MAGNIREVERSA**, new species.

Plate 136, figs. 13–23.

*Description.*—The zoarium is long, thin, linear, bifurcated, with oval transverse section much higher than wide. The fascicles are salient, close together, adjacent to the median crest, and arranged alternately on each side of it; they contain three or four zooecia. The tubes are visible, convex, with square or orbicular peristome. The *dorsal* is semicylindrical, very *large*, much larger and thicker than the frontal, striated longitudinally by the tubes.

| | | |
|---|---|---|
| *Measurements.*— | Diameter of the zooecia | 0.12 mm. |
| | Distance between the fascicles | 0.20–0.24 mm. |
| | Width of the fascicles | 0.15 mm. |
| | Width of the zoarium | 0.40 mm. |

*Variations.*—The fragments of the zoarium are quite regular in their general aspect, just as is also the number of the zooecia to the fascicles (figs. 15, 16). The only variation is in the size of the dorsal, which is in rapport with the proximity of the base. The great number of the incomplete zooecia at the extremity of the branches (fig. 16) and the extraordinary development of the dorsal indicates a very long zoarium and of a relatively rather great solidity.

The longitudinal section (fig. 21) indicates tubes of an extraordinary length. The habitual small pores are rather difficult to see on the tangential sections (fig. 20), where the length of the lozenge-shaped spindles confirm the early origin of the tubes and their length (fig. 19).

*Affinities.*—This species is easily confused with *Idmidronea maxillaris* Lonsdale, 1845, in which the dorsal presents the same great development. It differs from it in the complete absence of firmatopores which are visible either by abrasion, or in longitudinal sections.

It differs from *Idmonea tumida* Smitt, 1866, in the much less separation of the fascicles (0.20 and not 0.50 mm.).

*Occurrence.*—Middle Jacksonian (Castle Hayne limestone): Wilmington, North Carolina (very common).

Upper Jacksonian (Ocala limestone): Alachua, Florida (rare); west bank Sepulga River, Escambia County, Alabama (rare).

*Cotypes.*—Cat. No. 65352, U.S.N.M.

### IDMONEA GRALLATOR, new species.

Plate 138, figs. 1–20.

*Description.*—The zoarium is small, filiform, linear, bifurcated, horizontal, with oval transverse section which is a little higher than wide. The fascicles are salient, little oblique, arranged alternately on each side of the median axis and quite distant from it. They are formed by four or five zooecia, the last of which is quite small. The tubes are visible, flat, separated by a salient thread. The basal lamella is convex, flat, or somewhat concave; it is striated longitudinally by the tubes and transversally by the convex zones of growth; it bears radicells of consolidation. The ovicell is quite elongated between six or seven fascicles.

| | | |
|---|---|---|
| *Measurements.*— | Diameter of the tubes | 0.12 mm. |
| | Distance between the fascicles | 0.34–0.40 mm. |
| | Width of the fascicles | 0.14 mm. |
| | Width of the zoarium | 0.8 mm. |

*Variations.*—The fascicles are quite salient and quite divergent from the median crest (figs. 2, 3); abrasion lessens this character (fig. 6). The dorsal is quite variable; it is flat on the young branches (fig. 8); but the older branches are convex (fig. 9).

The base of the zoarium is quite wide; the branches are arranged horizontally (fig. 19); the first bear radicells of consolidation, like small *stilts* (fig. 20) which separate all the branches from the substratum. A section (fig. 15) taken through these radicells shows that they are formed of ordinary zooecia curved as usual and which were probably deprived of ordinary polypides.

We are not certain that the ovicell shown in figure 12 really belongs to this species; it is the only fragment found at this locality and the oeciostome is quite clearly preserved on it.

*Affinities.*—The calcareous radicells are not rare. They have already been noted by Smitt, 1872, in *Idmonea milneana* D'Orbigny, 1839, by Kirkpatrick, 1888, in *Idmonea radicata*, and by Norman, 1909, in *Idmonea pedata*.

This species differs from *Idmonea pedata* Norman in its less salient fascicles and in having five zooecia (and not three) to a fascicle.

It differs from *Idmonea radicata* in the nature of its ovicells; Kirkpatrick's species belongs to another family.

The difference between the fossil fragments and *Idmonea atlantica* Johnston, 1847, is quite difficult to determine most of the time. It is preferable not to determine the specimens which are not very well preserved. They differ from it in a lesser divergence of the fascicles on the median line and chiefly in the interfascicular distance which is less than 0.40 (and very rarely more than 0.40 mm.).

In its dorsal it resembles *Idmonea sloani*, but differs from it in its much greater interfascicular distance (0.40 and not 0.20 mm.).

The dorsal of this species corresponds well to Lonsdale's description of *Idmonea commiscens;* but we have never observed "the intermingling of mouths" mentioned and figured by that author. On the contrary, his *Idmonea* 14 of Rock Bridge conforms more to the present species.

*Occurrence.*—Middle Jacksonian: Wilmington, North Carolina (very common); Eutaw Springs, South Carolina (rare); 18 miles west of Wrightsville, Johnston County, Georgia (rare); near Lenuds Ferry, South Carolina (common).

Upper Jacksonian (Ocala limestone): Chipola River east of Marianna, Jackson County, Florida (very rare); west bank Sepulga River, Escambia County, Alabama (rare); below Plant System railroad wharf, Bainbridge, Georgia (very rare).

Vicksburgian (Red Bluff clay): Seven and one-half miles southwest of Bladen Springs, Alabama (rare).

Vicksburgian (Marianna limestone): One mile north of Monroeville, Alabama (very common); near Claiborne, Monroe County, Alabama (very rare).

*Cotypes.*—Cat. Nos. 65414–65416, U.S.N.M.

### IDMONEA ATLANTICA Johnston, 1847.

Plate 140, figs. 1–13.

1847. *Idmonea atlantica* (Forbes Mss.) Johnston, A History of the British Zoophtyes, 2 ed., p. 278, pl. 48, figs. 3, 3.

1856. *Idmonea atlantica* Busk, Polyzoa collected by Mr. McAndrew on the coasts of Norway and Finland in 1856, Annals and Magazine Natural History, ser. 2, vol. 18, p. 34, pl. 1, figs. 6*a*–*e*.

1858. *Idmonea atlantica* Busk, Zoophytology, On some Maderian Polyzoa, Quarterly Journal Microscopical Science, vol. 6, p. 128, pl. 18, fig. 5.

1875. *Idmonea atlantica* (part) Busk, Catalogue of Marine Polyzoa in the collection of the British Museum, pt. 3, Cyclostomata, p. 11.

1880. *Idmonea atlantica* Hincks, History of British Marine Polyzoa, p. 451, pl. 65, figs. 1–4.

1886. *Idmonea atlantica* (part) Busk, Report on the Polyzoa collected by H. M. S. *Challenger* during the years 1873–1876, vol. 50, p. 10.

1890. *Idmonea atlantica* Ortmann, Archiv. für Naturgeschichte, vol. 1, Heft 1, p. 58, pl. 4, figs. 20*a*, *b* (var. *disticha* Ortmann).

1894. *Idmonea atlantica* Levinsen, Mosdyr. Zoologica Danica (Danske Dyr.), vol. 4.

1895. *Idmonea atlantica* (det. R. Kirkpatrick) Thurston, Rámésvaram Island and Fauna G. Manaar, Madras Government Museum, Bull. 3, p. 131.

1900. *Idmonea atlantica* Neviani, Monographia del genere Idmonea Bryozoa Ciclostomata, pt. 1, pp. 6, 46 (synonomy); 1901, pt. 2, cap. 2, p. 74.

1903. *Idmonea atlantica* Jullien and Calvet, Résultats des Campagnes scientifiques du Prince du Monaco, Fascicule 23, p. 113.

1904. *Idmonea atlantica* Waters, Bryozoa from Franz-Josef Land, pt. 2, Journal Linnean Society, Zoology, vol. 29, pp. 166, pl. 21, figs. 2, 3 (the ovicell here figured is unusually short).

1904. *Idmonea atlantica* Waters, Bryozoa Résultats voyage *Belgica*, Zoologica, p. 90, pl. 9, fig. 5.

1906. *Idmonea atlantica* Nordgaard, Bryozoa from the 2d *Fram* Expedition, 1898–1902, Report Second Norwegian Arctic Expedition 1898–1902, No. 8, p. 38.

1907. *Idmonea atlantica* Calvet, Note par les expeditions du *Travailleur* et *Talisman*, vol. 8, p. 469.

1909. *Idmonea atlantica* Norman, The Polyzoa of Madeira and neighboring Islands, Journal Linnean Society, Zoology, vol. 30, p. 278, pl. 33, figs. 1, 2.

1912. *Idmonea atlantica* Thornely, Marine Polyzoa of the Indian Ocean, Transactions Linnean Society, Zoology, ser. 2, vol. 15, p. 156.

1912. *Tubulipora atlantica* Osburn, The Bryozoa of the Woods Hole Region, Bulletin of the Bureau of Fisheries, vol. 30, 1910, p. 217, p. 19, figs. 9, 9*a*.

1886. *Tubulipora atlantica*, forma *erecta* Smitt, Kritisk förteckning öfver Skandinaivens Hafsbryozoer, Öfversigt af. Kongl. Vetenskaps-Akademiens Fördhandlingar, vol. 23, pp. 399, 434, pl. 3, figs. 6–7, pl. 4, figs. 3–13 (ovicell figured).

1849. *Idmonea radians* Van Beneden, Recherches sur les Bryozoaires de la mer du nord (suite) et projet d'une classification des Bryozoaires, Bulletin l'Academie Royale de Belgique, vol. 16, p. 646, pl. 1, figs. 4–6.

1916. *Tubulipora atlantica* Harmer, The Polyzoa of the *Siboga* expedition, vol. 1, p. 124, pl. 10, figs. 4–5.

*Description.*—The zoarium is free, linear, bifurcated, with subcircular transverse section. The fascicles are salient, quite removed from the median crest, arranged alternately on each side of it, much protruding beyond the zoarial margins; they are formed of three to five zooecia the first of which is the longer and hides the others more or less. The basal lamella is somewhat striated longitudinally by the tubes, striated transversally by quite separated convex wrinkles; it is round or flat and more or less bordered laterally. The ovicell is much elongated, convex, scarcely lobed, placed on the median crest among five or six fascicles.

*Measurements.*—
Distance between the fascicles______ 0.48 (0.40–0.60 mm.).
Width of the fascicles______________ 0.14 mm.
Width of the zoarium________0.60 (without the fascicles).

*Variations.*—The dorsal is round at the base of the branches (fig. 9) and flat on the younger branches (figs. 7, 8); the two forms are often visible on the same branch (fig. 4). The fascicles are quite fragile and break easily (fig. 6); but the fossils thus altered are exceedingly difficult of determination and are almost identical with the linear branches of *Idmonea petri* D'Archiac, 1847.

In a single instance only have we observed a very short radicell (fig. 10).

The tangential (fig. 12) and longitudinal sections (figs. 11) offer no special features; but the transverse section has a very special form, for it is almost circular or semicircular according to the form of the dorsal.

*Affinities.*—Our fossil specimens have the aspect of the figures by Smitt, 1866; Hincks, 1880; Manzoni, 1877; and Busk, 1875. However, the micrometric measurements are generally smaller, although they are, on the contrary, essentially the same as those of specimens dredged in the Mediterranean.

In general aspect our specimens are quite different from the figures by Osburn, 1914, and Harmer, 1916, but the micrometric dimensions are closer.

In 1909, Canu, deceived by an excellent figure by Milne-Edwards, 1838, identified *Idmonea atlantica* with *Idmonea coronopus* Defrance, 1821. He is not now so sure, for he has been unable to find in the museum Milne-Edwards's type and the micrometric measurements of the French specimens (interfascicular distance= 0.30–0.40 mm.) are still less than those of our American specimens.

This species differs from *Tervia tumida* Smitt, 1871, in an interfascicular distance somewhat smaller and in its fascicles which are much more protruding beyond the zoarium.

The difference from *Idmonea grallator* in the absence of the radicells is quite difficult to note at sight. It can be made out only under the microscope, the interfascircular distance being always greater than 0.40 mm.

*Occurrence.*—Middle Jacksonian: Wilmington, North Carolina (very common); one-half mile southeast of Georgia Kaolin Co. mine, Twiggs County, Georgia (rare); 12 miles southeast of Marshallville, Georgia (rare).

Upper Jacksonian (Ocala limestone): Chipola River, east of Marianna, Jackson County, Florida.

Vicksburgian (Marianna limestone): One mile north of Monroeville, Alabama (rare).

*Plesiotypes.*—Cat. No. 65353, U.S.N.M.

### IDMONEA PARVULA, new species.

Plate 138, figs. 21–23.

*Description.*—The zoarium is free, *very small*, linear, bifurcated with triangular transverse section. The fascicles are little salient, much scattered, arranged alternately on each side of the median crest, extending very little over the zoarial margins; they are formed of two or three small, equal zooecia. The tubes are small, visible, convex. The dorsal lamella is very convex, smooth.

| | | |
|---|---|---|
| *Measurements.*— | Diameter of the tubes | 0.06 mm. |
| | Distance between the fascicles | 0.50–0.60 mm. |
| | Width of the fascicles | 0.10 mm. |
| | Width of the zoarium | 0.36 mm. |

*Affinities.*—This is the smallest of our American species. It resembles somewhat *Idmonea filiformis* in the narrowness of the zoarium; but it differs from it in the frequent bifurcation of the zoarium and in a lesser interfascicular distance (0.50 and not 0.90 mm.).

*Occurrence.*—Middle Jacksonian: Eighteen miles west of Wrightsville, Johnston County, Georgia (rare).

*Holotype.*—Cat. No. 65417, U.S.N.M.

### IDMONEA FILIFORMIS, new species.

Plate 138, figs. 24–27.

*Description.*—The zoarium is linear, very long, very thin, filiform. The fascicles are little salient, arranged alternately on each side of the median line and extending very little beyond the zoarial margins; they are formed by two zooecia only. The tubes are visible and convex. The dorsal lamella is round and smooth.

| *Measurements.*— | | |
|---|---|---|
| | Diameter of the tubes | 0.15 mm. |
| | Distance between the fascicles | 0.90–1.10 mm. |
| | Width of the fascicles | 0.15 mm. |
| | Width of the zoarium | 0.50 mm. |

*Affinities.*—This species presents the aspect of *Idmonea unipora* D'Orbigny, 1852, figured by Beissel, 1865, with two zooecia to the fascicle; but the interfascicular separation is much greater.

*Occurrence.*—Middle Jacksonian (Castle Hayne limestone): Wilmington, North Carolina (rare).

*Cotypes.*—Cat. No. 65418, U.S.N.M.

### IDMONEA PETRI D'Archiac, 1846.

Plate 139, figs. 1–13.

1846. *Idmonea petri* D'ARCHIAC, Description des fossiles recueillis par M. Thorent dans les couches nummulitiques des environs de Bayonne, Mémoires de la Société géologique de France, ser. 2, vol. 2, p. 195, pl. 5, fig. 11.

1908. *Idmonea non reticula* BEUTLER, Beitrag zur Kenntnis der Bryozoenfauna der älteren Tertiarschichten des südlichen Bayern, Cyclostomata, Paleontographica, vol. 59, p. 226, pl. 23, figs. 17, 18.

1911. *Idmonea petri* CANU, Bryozoaires des Sud-Ouest de la France, Bulletin de la Société géologique de France, ser. 4, vol. 11, p. 452, pl. 8, figs. 1–2 et 10–11.

*Description.*—The zoarium is large, linear, or somewhat claviform, compressed, with triangular transverse section. The fascicles are very salient, close together, not extending beyond the zoarial margins, opposite on each side of the median axis: they are formed of four to six equal zooecia. The tubes are visible, flat, often separated by a salient thread. The basal lamella is somewhat concave, excavated, and bordered by a margin of little thickness; it is smooth, slightly striated transversely and longitudinally.

| *Measurements.*— | | |
|---|---|---|
| | Diameter of the tubes | 0.14 mm. |
| | Distance between the fascicles | 0.30–0.40 mm. |
| | Width of the fascicles | 0.12 mm. |
| | Width of the zoarium | 1.2 mm. |

*Affinities.*—The determination has been made specimen by specimen with the French material, but it may be possible that this species has been described under another name by the paleontologists. *Idmonea disticha* Reuss, figured by Manzoni in 1877, is exteriorly very close, but the fascicles are clearly alternated, which is not the case in all our specimens. Moreover. the micrometric measurements do not appear identical, if the small drawing of Manzoni is exact. It is to be noted that figure 6 represents a branch with alternated fascicles.

A species, also very close, is *Idmonea marginata* D'Orbigny, 1853, of the European Senonian. If we consider, for example, figure 8, with its eight tubes to the fascicle, the identity is perfect. The zooecial and zoarial dimensions are also identical. The only appreciable difference is that the number of the tubes to the fascicle is frequently larger than in the Tertiary species. The study of bases and ovicells will perhaps permit us some day to make better comparisons.

This species differs from *Idmonea arcuata* in the linear form of its zoarium and in the distance between the fascicles being double. It differs from *Idmonea sloani* in its larger dimensions and in its transverse section wider than high.

*Occurrence.*—Middle Jacksonian: Wilmington, North Carolina (very rare); near Lenuds Ferry, South Carolina (rare); Eutaw Springs, South Carolina (rare).

Vicksburgian (Marianna limestone): West bank Conecuh River, Escambia County, Alabama (very common).

Vicksburgian (Byram marl): One-fourth mile west of Woodwards, Wayne County, Alabama (rare).

*Geological distribution.*—Lutetian of Bavaria (Beutler); Auversian at Biarritz (Canu).

*Plesiotypes.*—Cat. Nos. 65355, 65356, U.S.N.M.

### IDMONEA TRIFORATA Canu, 1911.

Plate 161, figs. 5–24.

1911. *Idmonea triforata* Canu, Les Bryozoaires du Sud-Ouest de la France, Bulletin de la Société géologique de France, ser. 4, vol. 11, p. 452, pl. 8, figs. 13–14.

*Description.*—The zoarium is free, linear, bifurcated, with triangular transverse section wider than high. The fascicles are very salient, irregularly spaced, arranged alternately on each side of the median crest and distant from it, projecting beyond the zoarial margins; they are formed of three or four zoecia, the last of which is turned and opens on the dorsal face and the first is isolated on the young branches. The tubes are visible. long, convex; the peristome is quadrangular. The basal lamella is smooth and somewhat convex.

| *Measurements.*— | | |
|---|---|---|
| | Diameter of the tubes | 0.20–0.24 mm. |
| | Distance between the fascicles | 0.70–1.00 mm. |
| | Width of the fascicles | 0.14–0.16 mm. |
| | Zoarial width | 0.75 mm. |

*Variations.*—This species is exceedingly irregular; the distance between the fascicles has no constancy and varies from 1 to 2 times (0.60 to 1.20). On the terminal branches the first zooecium of each fascicle is isolated on the median axis of the zoarium (figs. 7, 8, 14, 15) and measures 0.30 mm. in diameter. On the branches of the base or lower branches the fascicles are regular and complete (figs. 12, 13). This double disposition is often visible on the same specimen.

Some branches (figs. 14, 15) are beyond all description on account of their great irregularity. The fascicles are quite salient (figs. 7, 8, 14), but they are fragile and break easily (fig. 16).

The fascicles are quite distant from the median crest; also on the longitudinal sections there are no zooecia with the apertura visible (fig. 22). In order to see the apertura of the zooecia it is necessary to make a meridian section by the prolonged abrasion of the frontal (fig. 23).

The miscroscopic structure of the zooecial walls (fig. 24) is rather difficult to comprehend.

*Affinities.*—This species is quite odd and easy to determine; it is impossible to confuse it with the others. One can not determine the isolated branches, for the reader can believe in the existence of many species of which intermediate stages appear in large numbers of specimens.

The comparison with the French species has been made specimen with specimen and the identification is absolutely certain.

*Occurrence.*—Vicksburgian (Marianna limestone): Salt Mountain, 5 miles south of Jackson, Alabama (common); near Claiborne, Monroe County, Alabama (common); Murder Creek, east of Castlebury, Conecuh County, Alabama (very common); west bank Conecuh River, Escambia County, Alabama (very common); Escambia County, Alabama (deep well) (rare).

Vicksburgian (Byram marl): One-fourth mile west of Woodwards, Wayne County, Mississippi (common).

*Geological distribution.*—Auversian of Biarritz (Canu).

*Plesiotypes.*—Cat. Nos. 65441–65445, U.S.N.M.

### **IDMONEA GRANDIORA, new species.**

Plate 162, figs. 1–3.

*Description.*—The zoarium is free, linear, fixed by an expanded base, compressed. The fascicles are somewhat salient, close together, arranged alternately on each side of the median line and formed of three equal zooecia. The tubes are invisible; the peristome is thin; the *apertura* is *large*.

| | | |
|---|---|---|
| *Measurements.*— | Diameter of the zooecia | 0.20 mm. |
| | Distance between the fascicles | 0.20–0.22 mm. |
| | Width of the fascicles | 0.16–0.18 mm. |
| | Width of the zoarium | 0.60 mm. |

*Affinities.*—Only the three specimens figured have been found. They are of interest merely on account of their great apertura and because this species exists in the strata of Vicentin where Canu has recently discovered it.

*Occurrence.*—Vicksburgian (Marianna limestone): One mile north of Monroeville, Alabama (rare).

*Geological distribution.*—Priabonian of the Vicentin.

*Holotype.*—Cat. No. 65472, U.S.N.M.

## IDMIDRONEA, new genus.

The zoarium is idmoneiform. The dorsal bears firmatopores or canals of reinforcement.

*Genotype.—Idmidronea coronopus* Defrance, 1822.

*Range.*—Lutetian-Jacksonian.

The firmatopores are small canals, very thin and numerous, which develop on the dorsal of the zoarium in great thickness. They are parallel and very long, for we have followed them throughout the length of a branch. In a longitudinal section they appear somewhat intermingled, for it is absolutely impossible to prepare a section in a position exactly parallel to their general direction. On the dorsal they appear as very small, longitudinal striations extremely numerous and quite close together. In *Idmonea*, on the contrary, the longitudinal striations are much more scattered and limit the tubes themselves which are entirely visible. The tergopores are much larger. The firmatopores are evidently intended to reinforce the consolidation of the branches. It is almost certain that they indicate a zoarium which is horizontal or arranged in a much expanded bush-like shape. All of the branches are not provided with firmatopores and the generic classification is then very difficult.

We have not found the ovicell, so the place of this genus in the family of the Tubuliporidae is naturally hypothetical.

### IDMIDRONEA ROSACEA, new species.

Plate 132, figs. 11–15.

*Description.*—The zoarium is supported on a more or less expanded base which forms a trunk of greater or less size; the branches are directed horizontally in all directions from the center like the petals of a *rose*. They are bifurcated and their section is triangular. The fascicles are very little salient and bear only two or three zooecia; they are alternated on each side of the median line. The tubes are invisible; the peristomes are thin, round, or rectangular. On the dorsal the firmatopores are arranged longitudinally; they are rather large and their visible orifice, which results from abrasion, is polygonal.

| | | |
|---|---|---|
| *Measurements.*— | Diameter of the tubes | 0.16 mm. |
| | Width of the fascicles | 0.16 mm. |
| | Distance between the fascicles | 0.32 mm. |
| | Width of the branches toward the base | 2.00 mm. |

*Affinities.*—This superb species is rather rare. It is remarkable because it appears to be formed of two symmetrical zoaria arranged horizontally on each side of the ancestrular center.

It differs from *Idmidronea maxillaris* Lonsdale, 1847, in the rotate form of its zoarium and in its nonsalient fascicles, and from *I. culter* in its fascicles, which are more scattered, more distinct, never adjacent on the median line.

*Occurrence.*—Middle Jacksonian (Castle Hayne limestone): Wilmington, North Carolina (rare).

*Cotypes.*—Cat. No. 65359, U.S.N.M.

### IDMIDRONEA MAXILLARIS Lonsdale, 1845.

Plate 131, figs. 1–7.

1845. *Idmonea maxillaris* LONSDALE, Account of 26 species of Polyparia obtained from the Eocene-Tertiary formation of North America, Quarterly Journal Geological Society, London, vol. 1, p. 523, fig.

1862. *Idmonea maxillaris* GABB and HORN, Monograph fossil Polyzoa of the Secondary and Tertiary formations of North America, Journal Academy Natural Sciences, Philadelphia, ser. 2, vol. 5, p. 167.

*Description.*—The zoarium is formed of triangular, linear, irregular branches more or less distorted and cervicorn. The fascicles are very salient, quite close together, arranged alternately on each side of the median crest; they are formed of three zooecia. The tubes are invisible; the peristomes are thin and round. The dorsal is striated by numerous parallel firmatopores.

| | | |
|---|---|---|
| *Measurements.*— | Diameter of the tubes | 0.16–0.20 mm. |
| | Distance between the fascicles | 0.30–0.40 mm. |
| | Width of the fascicles | 0.17 mm. |
| | Width of the branches | 1.00 mm. |

*Affinities.*—The species is remarkable for the extraordinary development of the dorsal formed of a great number of firmatopores. They form a very thick collar on which the fascicles appear to incrust. In this respect the species much resembles *Idmonea magnireversa*, but differs from it in its totally different longitudinal section, owing to the presence of innumerable firmatopores.

It differs from *Idmidronea rosacea* and *Idmidronea culter*, which have an identical transverse section, in the great saliency of the fascicles.

*Occurrence.*—Middle Jacksonian: Wilmington, North Carolina (very common); near Lenuds Ferry, South Carolina (very common); Wantoot, South Carolina (type locality).

*Plesiotypes.*—Cat. No. 65360, U.S.N.M.

### IDMIDRONEA CULTER, new species.

Plate 132. figs. 1–10.

*Description.*—The zoarium is formed of long, linear branches bifurcated with triangular transverse section. The fascicles are little distinct, not salient, quite close together, and formed of three, four, or five zooecia; they are alternated on each side of the median crest, but they are adjacent to each other with the least abrasion. The tubes are invisible; the peristome is small, thin, round. The dorsal is semicylindrical, very thick, striated longitudinally by its large firmatopores.

The transverse section is triangular; it has the form of a very thick *knife*, round at the back. This is always higher than wide, but the relation of the two dimensions is not constant.

*Affinities.*—We have hesitated much to separate this species from *Idmonea maxillaris* Lonsdale, 1845, of which it appears to be a condition of weathering.

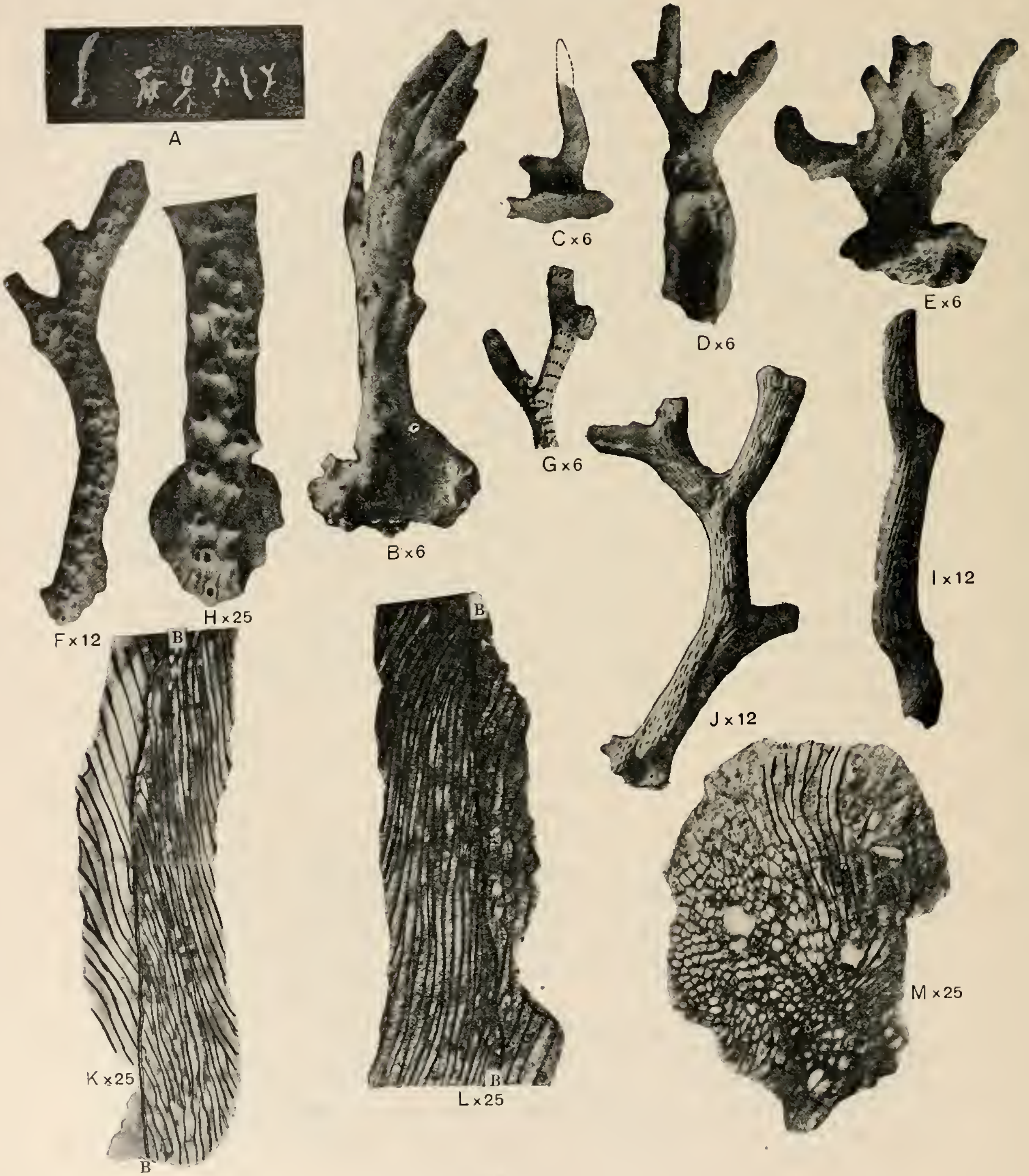
A
C x 6
D x 6
E x 6
B x 6
G x 6
F x 12
H x 25
I x 12
J x 12
B
B
K x 25
B
L x 25
B
M x 25

Fig. 253.—*Idmidronea*, new genus.

Fig. 253.—*Idmidronea*, new genus.

A–L. *Idmidronea* (*Idmonea*) *coronopus* Defrance, 1822. A. Zoaria, natural size, from various localities in the Lutetian of France. B. Zoarium, × 6, with layer of firmatopores forming many columns (on rocks). C. Specimen, × 6, with a small basal plate of firmatopores (incrusting shells), bearing a branch without firmatopores. D. A concave base of firmatopores, × 6, attached to an alga. E. A large base, × 12, without firmatopores. The ancestrular zooecium is visible. F. A small base, × 12, without firmatopores. The ancestrular zooecium is visible. G. The same specimen, × 25, showing absence of firmatopores. H. An example, × 6, showing that the layer of firmatopores is separable. I. Specimen, × 12, showing that there are many layers of firmatopores. J. The firmatopores occur at the bottom of sulci, × 12. K. Longitudinal section in a thick zoarium through the axis of the fascicles, × 25. The basal lamella (*BB*) is visible. The firmatopores are the cylindrical tubes growing on the basal lamella but directed toward the base while the polypidian tubes are ascending. L. Longitudinal section, × 25, in the thick zoarium taken between the fascicles and in the axis of a bifurcation. The basal lamella (*BB*) is visible. M. Thin section in the base of a zoarium, × 25.

In our very numerous materials we have not been able to discover the transition forms necessary for the union of the two species. Moreover, the branches with distinct fascicles are very rare; the branch represented in figure 2 is the usual occurrence.

The size of the firmatopores is visible on the tangential section, where they appear under the form of short, rather wide spindles.

This species much resembles *Idmonea commiscens* Lonsdale, 1845. It differs from it absolutely only in its dorsal, which is never flat, contrary to what the author thought (p. 525). It is possible that Lonsdale was considering two species among his specimens.

*Occurrence.*—Middle Jacksonian: Wilmington, North Carolina (very common); near Lenuds Ferry, South Carolina (very common); Eutaw Springs, South Carolina (rare).

*Cotypes.*—Cat. No. 65358, U.S.N.M.

## TERVIIDAE, new family.

The longitudinal axis of the ovicell is parallel to that of the tubes. The ovicell is formed after the calcification of the neighboring tubes. The oeciostome is directed toward the top.

We recognize three genera in this family, *Tervia* Jullien, 1882, *Prosthenoecia* Canu, 1918, and *Lagonoecia*, new genus.

### Genus TERVIA Jullien, 1882.

1882. *Tervia* JULLIEN, Dragages du *Travailleur* Bryozoaires espèces dragnées dans l'océan Atlantique en 1881, Bulletin Société Zoologique France, vol. 7, p. 4.

The ovicell is developed on the posterior and noncelluliferous (dorsal) face of the zoarium.

*Genotype.*—*Tervia* (*Tubulipora*) *irregularis* Meneghini, 1845.

*Range.*—Lutetian-Recent.

The genus *Tervia* is characterized not only by its ovicell, but also by the aspect of its dorsal, for the tubes here are flat and separated by a salient thread. Moreover, on the frontal the fascicles are never parallel to each other as in *Idmonea*.

#### TERVIA GRACILIS, new species.

Plate 147, figs. 1–11.

*Description.*—The zoarium is free, bifurcated, *slender*, compressed. The tubes are distinct, separated by a salient thread, arranged in nonparallel fascicles; the peristome is thin, elliptical. The ovicell is very long and curves around almost all the dorsal. The dorsal is convex; the tubes are flat and separated by a salient thread.

| | | |
|---|---|---|
| *Measurements.*— | Distance between the fascicles (measured on the dorsal) | 0.36 mm. |
| | Diameter of the peristome | 0.12 mm. |
| | Width of the fascicles | 0.10 mm. |
| | Number of peristomes to the fascicles | 3.4 |

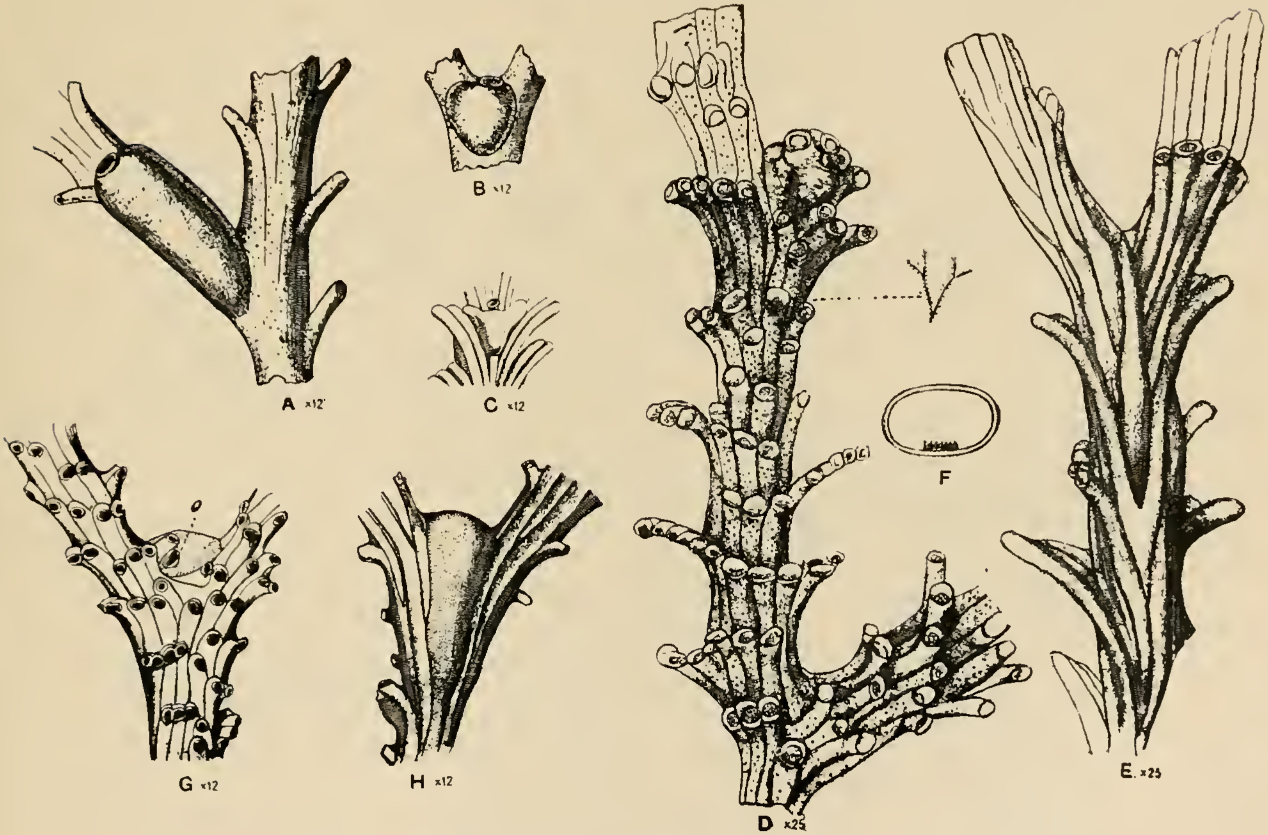

FIG. 254.—Genus *Tervia* Jullien, 1882.

A–F. *Tervia irregularis* Meneghini, 1845. A, B. Normal and short ovicelli, × 12. (After Waters, 1888.) C. Cordiform ovicell, × 12. (After Jullien, 1903.) D, E. The two faces of the zoarium. (After Harmer, 1915.) F. Comb-like process in the zooecial tube near where it becomes erect. (After Waters, 1914.)

G, H. *Tervia jellyae* Harmer. 1915. The two faces, × 12, *o*, oeciostome. (After Harmer, 1915.)

*Variations.*—The tubes are arranged sometimes in quincunx, sometimes in verticells, and sometimes in fascicles; the last arrangement is more frequent. The convexity of the dorsal is quite variable.

In longitudinal section the tubes are very long.

The fascicles are salient on each side of the zoarium viewed from the dorsal.

*Affinities.*—This species differs from *Tervia irregularis* Meneghini, 1845, in its smaller interfascicular distance (0.36 and not 0.60 mm.) and in its more narrow and slender branches.

It differs from *Tervia bialternata* Gregory, 1892, and from *Tervia filiformis* D'Orbigny, 1852, in its large micrometric measurements.

*Occurrence.*—Middle Jacksonian: Wilmington, North Carolina (very common); near Lenuds Ferry, South Carolina (very common).

Upper Jacksonian (Ocala limestone): West bank Sepulga River Escambia County, Alabama (very rare); Alachua, Florida (rare).

*Cotypes.*—Cat .No. 65.434, U.S.N.M.

### TERVIA PARVULA, new species.

Plate 147, figs. 12–14.

*Description.*—The zoarium is formed of small compressed branches. The tubes are distinct, separated by a salient thread, arranged in quincunx or in irregular rows; the peristome is thin, *small*, orbicular, salient. On the dorsal the tubes are separated by a salient thread and superposed in lozenge-shaped areas.

| | | |
|---|---|---|
| *Measurements.*— | Diameter of the peristome | 0.10 mm. |
| | Distance between the peristomes | 0.30 mm. |
| | Width of the branches | 0.40 mm. |

*Affinities.*—This species differs from *Tervia gracilis* in its smaller micrometric dimensions. The few specimens collected bear no ovicells.

*Occurrence.*—Upper Jacksonian (Ocala limestone): Chipola River, east of Marianna, Jackson County, Florida (rare).

*Cotypes.*—Cat. No. 65435, U.S.N.M.

### TERVIA TUMIDA Smitt, 1871.

Plate 140, figs. 14–21.

1871. *Tubulipora (Idmonea) tumida* Smitt, Kritiske förteckning öfer Skandinaviens Hafsbryozoer, Ofversigt af Kongl. Vetenskaps-Akademiens Förhandlingar, vol. 28, p. 1116, pl. 20, figs. 5, 6, 7.

1903. *Idmonea tumida* Waters, Bryozoa from Franz-Joseph Land, Journal Linnean Society, London, vol. 29, p. 168, pl. 21, figs. 4, 5.

*Description.*—The zoarium, is free, linear, bifurcated, provided with radicells at the bifurcations, with subcircular transverse section. The fascicles are salient, quite far apart from each other and also from the median line, alternately arranged and extending beyond the zoarial margins; they are formed of three or four equal zooecia. The tubes are visible, flat, separated by a salient thread. The dorsal lamella is very convex and striated longitudinally by the tubes. The ovicell is globular, elliptical, very salient; the oeciostome is small, transverse, placed near the dorsal of the zoarium.

| | | |
|---|---|---|
| *Measurements.*— | Diameter of the tubes | 0.10 mm. |
| | Distance between the fascicles | 0.55–0.80 mm. |
| | Width of the fascicles | 0.10 mm. |
| | Width of the zoarium | 0.70 mm. |

*Affinities.*—This species constitutes a strong divergent type in the genus. Its exterior aspect is absolutely that of *Idmonea*, its ovicell is exactly that of *Tervia*. It is quite easy to determine in its interfascicular distance greater than in *Idmonea atlantica* Johnston, 1847, and all the other small American species.

It offers much the same aspect as *Idmonea hörnesi* Stoliczka, but differs from it in the very salient thread separating the zooecia and in the alternation of the fascicles (and not their opposite arrangement) on each side of the median crest.

Our specimens are in agreement with the figure given by Waters, 1903, but resemble less that of Smitt, 1871. On the latter the first zooecium of each fascicle is isolated, a feature that does not exist on Waters's figure nor on our specimens.

*Idmonea tumida* being an Arctic species, it is curious to find it fossil in an equatorial sea. However, the bryozoa appear much more sensible to the temperature of the bottom than to geographic position.

*Occurrence.*—Middle Jacksonian (Castle Hayne limestone): Wilmington, North Carolina (rare).

Upper Jacksonian (Ocala limestone): Chipola River, east of Marianna, Jackson County, Florida.

*Habitat.*—Arctic Ocean.

*Plesiotypes.*—Cat. No. 65354, U.S.N.M.

### TERVIA GLOBULIFERA, new species.

Plate 146, figs. 1–8.

*Description.*—The zoarium is free, bifurcated almost at right angles; the branches are elliptical in section and short, claviform in length; the posterior face is round, smooth, or slightly wrinkled transversally. The fascicles are formed of seven tubes; they are little salient, close together, invisible on the dorsal. The tubes are flat, visible, separated by a shallow furrow. The ovicell is *globular*, spherical, quite salient, placed at the bifurcations; the oeciostome is salient, transverse, a large lunar crescent in shape.

*Measurements.*—

Distance between the fascicles............ 0.25–0.33 mm.
Width of the fascicles.................... 0.16 mm.
Diameter of the largest tube.............. 0.16 mm.
Diameter of the zoarium................... 1.00 mm.
Number of tubes in the fascicles.......... 7

*Variations and Affinities.*—This species belongs to the *Tervia tumida* group, and without the presence of the ovicell placed dorsally it is impossible to classify specimens generically. It differs from *Tervia pyrifera*, with which it is associated in globular form of its ovicell, the smaller interfascicular distance (less than 0.35 mm.), larger tubes, fascicles which do not border the zooecial margins, and short claviform branches.

The zone of growth is short and thick.

The oeciostome is turned from the side of the dorsal contrary to the direction observed in the *Tervia irregularis* group where the oeciostome is turned from the side of the cellular face.

*Occurrence.*—Middle Jacksonian (Castle Hayne limestone): Wilmington, North Carolina, (rare).

*Cotypes.*—Cat. No. 65366, U.S.N.M.

### TERVIA PYRIFERA, new species.

Plate 146, figs. 9–12.

*Description.*—The zoarium is free and formed of bifurcated branches with elliptical transverse section; the dorsal is round and smooth. The fascicles are very salient and border the zoarial margins; they always contain about five tubes. The tubes are little convex, flat, distinct, separated by a slight furrow. The ovicell is large, globular, elongated, *pyriform*, placed at the bifurcation of the branches; the oeciostome is salient, elliptical, transverse.

| | | |
|---|---|---|
| *Measurements.*— | Distance between the fascicles | 0.50 mm. |
| | Width of the fascicles | 0.12 mm. |
| | Average diameter of the tubes | 0.08 mm. |
| | Diameter of the zoarium | 0.75 mm. |
| | Number of tubes to the fascicle | 5. |

*Affinities.*—Like *Tervia tumida* Smitt, this species belongs to the second group of *Tervia*, whose aspect is absolutely identical with that of typical *Idmonea*. It differs from it in its larger ovicell placed at the bifurcation of the branches and in a lesser interfascicular distance (less than 0.52 mm.).

This species differs from *Tervia globulifera* in its pyriform ovicell, its greater interfascicular distance, and in its fascicles bordering the zoarial margins.

*Occurrence.*—Middle Jacksonian (Castle Hayne limestone): Wilmington, North Carolina (rare).

*Holotype.*—Cat. No. 65367, U.S.N.M.

### LAGONOECIA, new genus.

Greek: *lagon*, flank, referring to the position of the ovicell.

The ovicell is symmetrical, globular, suspended on one of the sides of the zoarium; the oeciostome is transverse, terminal.

*Genotype.*—*Lagonoecia lamellifera*, new species. Lower Jacksonian.

### LAGONOECIA LAMELLIFERA, new species.

Plate 112, figs. 1–8.

*Description.*—The zoarium is an *Idmonea* with claviform, triangular, and often reticulate branches. The fascicles are formed of five to six tubes; they are arranged transversally and alternately on each side of the median axis; they are very salient and form like very oblique *lamellae*, imbricated one above another. The tubes are distinct, flat, bordered by a salient thread; the peristome is thin and quadrangular. The zone of growth is large, salient, and triangular. The posterior face (dorsal) is very finely striated longitudinally. The ovicell is large, very convex, elongated, elliptical, symmetrical, suspended on the lateral edge of the zoarium; the oeciostome is terminal, very large, transverse, fastened to a small isolated tube, and separated from the fascicles.

*Measurements.*—

| | |
|---|---|
| Diameter of the peristome | 0.10 mm. |
| Distance between the fascicles | 0.30 mm. |
| Width of the fascicles | 0.12 mm. |
| Width of the branches | 2.00 mm. |

*Variations.*—The lamellar fascicles are often oblique (fig. 3); the sixth tube, which composes them and which is placed in the vicinity of the lateral edge, is often isolated.

The ovicell is always placed laterally (fig. 1); its position is hardly disarranged at the bifurcations (fig. 2), even though this takes place at a very acute angle. It is remarkable that the oeciostome should be joined to a tube, but this tube does not belong to a fascicle, for it is always isolated.

The variation of the nature of the ovicells in species with the *Idmonea* form of growth is very great. This is a proof of the poor method followed even to this day by the naturalists is the classification of the cyclostomatous bryozoa. *Idmonea* unrestricted is only a zoarial form common to a great many families.

*Occurrence.*—Wilcoxian (Bashi formation): Woods Bluff, Alabama (common).

*Cotypes.*—Cat. No. 65264, U.S.N.M.

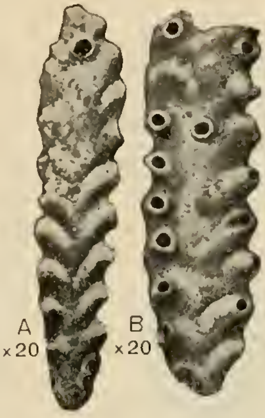

FIG. 255.—Genus *Prosthenoecia*) Canu, 1918. Two ovicelled zoaria of *Prosthenoecia* (*Reptotubigera*) *lateralis*, D'Orbigny, 1852, from the Lutetian of France.

### Genus PROSTHENOECIA Canu, 1918.

1918. *Prosthenoecia* CANU, Les ovicelles des bryozoaires cyclostomes, Bulletin Société géologique de France, ser. 4, vol. 16, p. 327.

The ovicell is placed on the celluliferous face; the oeciostome is large and transverse.

*Genotype.*—*Prosthenoecia* (*Reptotubigera*) *lateralis* D'Orbigny, 1852. Lutetian.

## Family HORNERIDAE Gregory, 1899.

*Anatomical bibliography.*—1888. WATERS, On some Ovicells of Cyclostomatous Bryozoa, Journal Linnean Society, London, Zoology, vol. 20, p. 275, pt. 14, figs. 1, 3, 4, 7.—1903. WATERS, Bryozoa from Franz-Joseph Land, pt. 2, Journal Linnean Society, London, Zoology, vol. 29, p. 168, pl. 20, figs. 1–6.—1904. WATERS, Expedition antarctic Belge, Bryozoa, p. 93, pl. 9, fig. 1.—1911. HENNIG, Le conglomérat pleistocene à Pecten de l'ile de Cockburn, Wissenshaftliche ergebnisse der schwedischen sudpolär expedition, vol. 3, p. 37, pl. 5, figs. 8–11.—1914. WATERS, Marine Fauna British East Africa and Zanzibar Bryozoa, Cyclostomata, Proceedings Zoological Society, London, p. 836.

The ovicell is symmetrical, sacciform, subglobular. The oeciostome is lateral and opens on the frontal. The zoarial walls are lamellose and squamous. They are traversed by vacuoles.

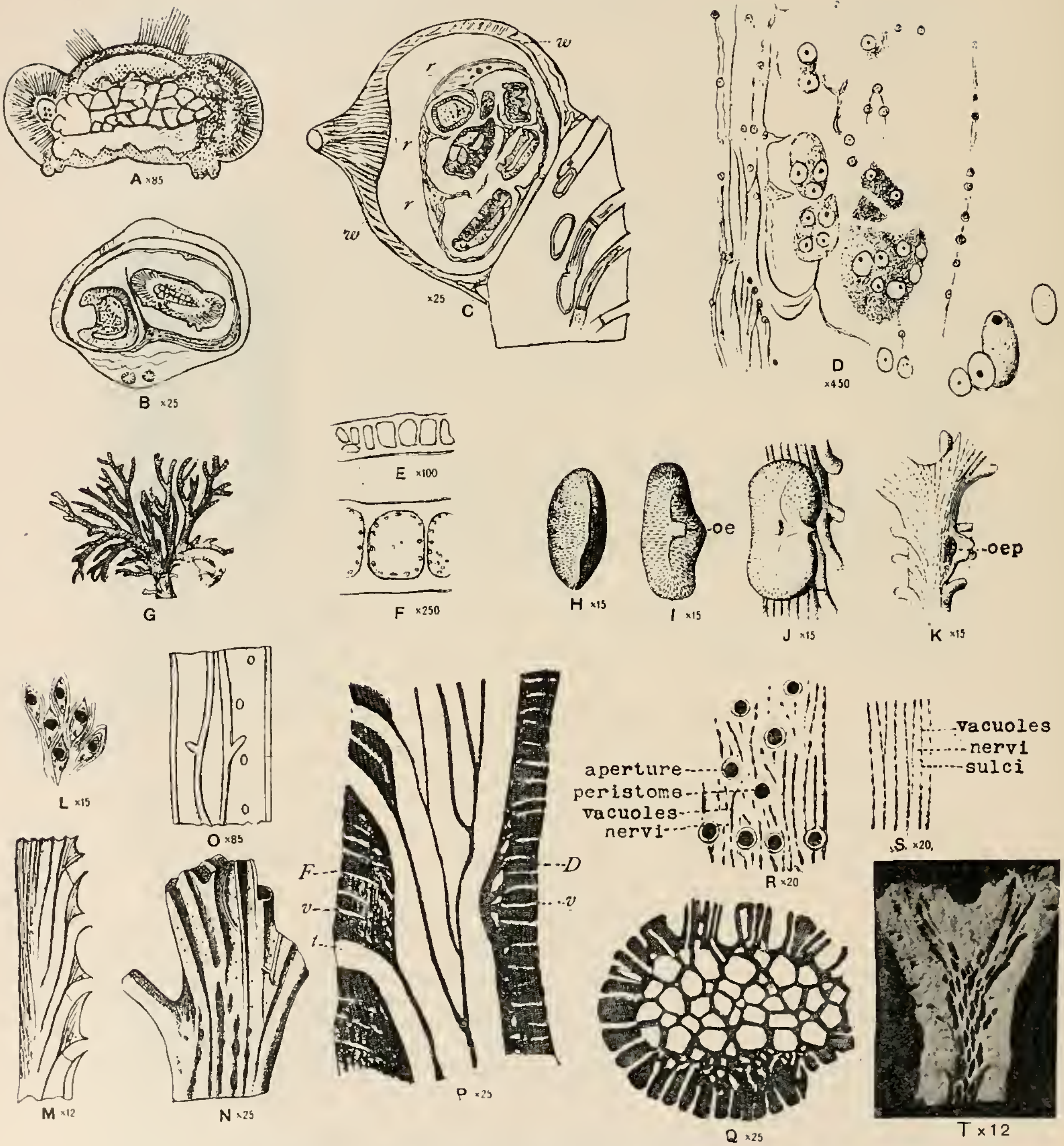
A ×85
w
r
r
r
w
×25
C
D
×450
B ×25
E ×100
F ×250
G
H ×15
I ×15
oe
J ×15
K ×15
oep
L ×15
O ×85
F
v
t
D
v
aperture
peristome
vacuoles
nervi
R ×20
vacuoles
nervi
sulci
S ×20
M ×12
N ×25
P ×25
Q ×25
T ×12

FIG. 256.—Anatomy of the family Horneridae Gregory, 1899.

FIG. 256.—Anatomy of the family Horneridae Gregory, 1899.

A–L. *Hornera lichenoides* Pontoppidam, 1752. A. Section of embryo, × 85. Whether the cilia on the upper part are in two tufts or are continuous is not clear. B. Transverse section of ovicell, × 25. C. Longitudinal section, × 25, showing the polypide and the ovicell, surrounded by the wall (*w*), from which the reticulum (*r*) has separated, no doubt in consequence of the processes of preservation and preparation. In the reticulum, on the left-hand side, some ovarian masses are seen. Six embryos are seen in the section. D. Section of protoplasmic reticulum containing ovarian masses, × 450. This reticulum is shown slightly magnified in fig. C. E. Section of the wall of the ovicell, × 100. F. Section of the wall of the ovicell, × 250. G. Zoarium, natural size. H–J. Ovicells, × 15, with lateral oeciostome (*oe*). K. Dorsal of a zoarium, × 15. The ovicell is broken and shows the interior of the oeciopore (*ocp*). L. Frontal, × 15. (After Waters, 1903, and Smitt, 1867.)

M. *Hornera concatenata* Reuss, 1869. Longitudinal section, × 12, showing terminal closure. (After Waters, 1884.)

N, O. *Hornera fissurata* Busk, 1884. N. Dorsal surface (growing end), × 25. O. Section of zooecial tubes, × 85, showing interior projections. (After Waters, 1888.)

P. *Hornera antarctica* Waters, 1904. Longitudinal section, × 25. (F, frontal and D, dorsal.) The scaly and lamellar structure is quite visible. The vacuoles (*v*) perforate the zoarium. The tubes (*t*) grow and bud as in the other Cyclostomata; they do not issue from a central canal as Hennig has incorrectly represented.

Q. Transversal section, × 25. All the polygonal tubes are approximately equal.

R, S. Frontal and dorsal, × 20, indicating the terminology peculiar to this family. (After Hennig, 1910.)

T. *Hornera jacksonica*, new species. Interior, × 12, showing that there is no sagittal canal.

The vacuoles[1] are the small, oblique, recurved tubules which irregularly perforate the zoarium. They open at the base of the sulci and they are separated by nervi or threadlike ridges which are longitudinal on the dorsal and often oblique on the frontal. The vacuoles apparently are not connected with the cavities of the zooecia.

The squamous composition of the zoarium seems to indicate an external origin somewhat analogous to the pleurocyst of the Cheilostomata, but the corresponding division into two of the ectocyst has not yet been observed, although it may be quite probable.

Hennig (fig. 256P) thought that the polypidian tubes were inserted on a longitudinal dorsal tube. Our longitudinal sections have not confirmed this observation. The successive ramification of the tubes is identical with that of other families. The removal of the dorsal shows the ordinary lozenge-shaped areas.

In horizontal section the tubes are perceptibly equal. They do not diminish from the circumference to the center as in the zoarial form *Entalophora*, therefore they are cylindrical.

The zoarium is often bushy; the frontal bearing the apertures is turned to the interior of the colony toward the median axis; the dorsal, on the contrary, is exterior. There are some flabelliform zoaria, but very rarely on the same plane.

The Horneridae are attached to rocks or algae by an expanded base.

The larva is the largest of the Cyclostomata. There are only a dozen embryos in the ovicell.

### Genus HORNERA Lamouroux, 1821.

1821. *Hornera* LAMOUROUX, Exposition methodique des genres de l'ordre des Polypiers, p. 41.

The ovicell is large, dorsal; its punctations or reticulations are large. The tubes are cylindrical with dorsal gemmation. The apertures are disposed only on the frontal. The vacuoles are arranged all over the zoarium at the base of longitudinal sulci. There are nine tentacles.

*Genotype.*—*Hornera frondiculata* Lamouroux. 1821.

*Range.*—Lutetian-Recent.

*Hornera* is quite well known and is a very natural genus. It is very common among the Tertiary fossils. Certain Cretaceous species have been cited, but we believe that it is necessary to await the description of their ovicells and of their sections before assigning them definitely to this genus.

The variations in this genus are extraordinary and it is often useless to attempt to determine an isolated specimen.

Species of *Hornera* are bryozoans of deep water. All the recent species live at variable but always very great depths. At 30 to 100 meters one may hope to find some examples, but it is at greater depths, from 100 to 300 meters these animals find the most favorable conditions for their development.

The thermal conditions of their habitat vary evidently with the depth, but in the rather restricted limits from —9°C. to +6°C.

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[1] Intermediate pores (D'Orbigny). Interskeletal cavities (Pergens). Branched maculae (Gregory). Adventitious pores (Waters).

### HORNERA JACKSONICA, new species.

Plate 143, figs. 1–26.

*Description.*—The zoarium is elliptical, ramified in the strict sense at a very acute angle. The tubes are invisible exteriorly; they bear from two to four vacuoles, two of which are adjacent to the apertura and are arranged at the base of one or two oblique sulci. The peristome is orbicular and little salient. The dorsal bears longitudinal sulci narrower than the nervi, and rather large vacuoles. The ovicell is elongated, elliptical, very globular, and quite punctate.

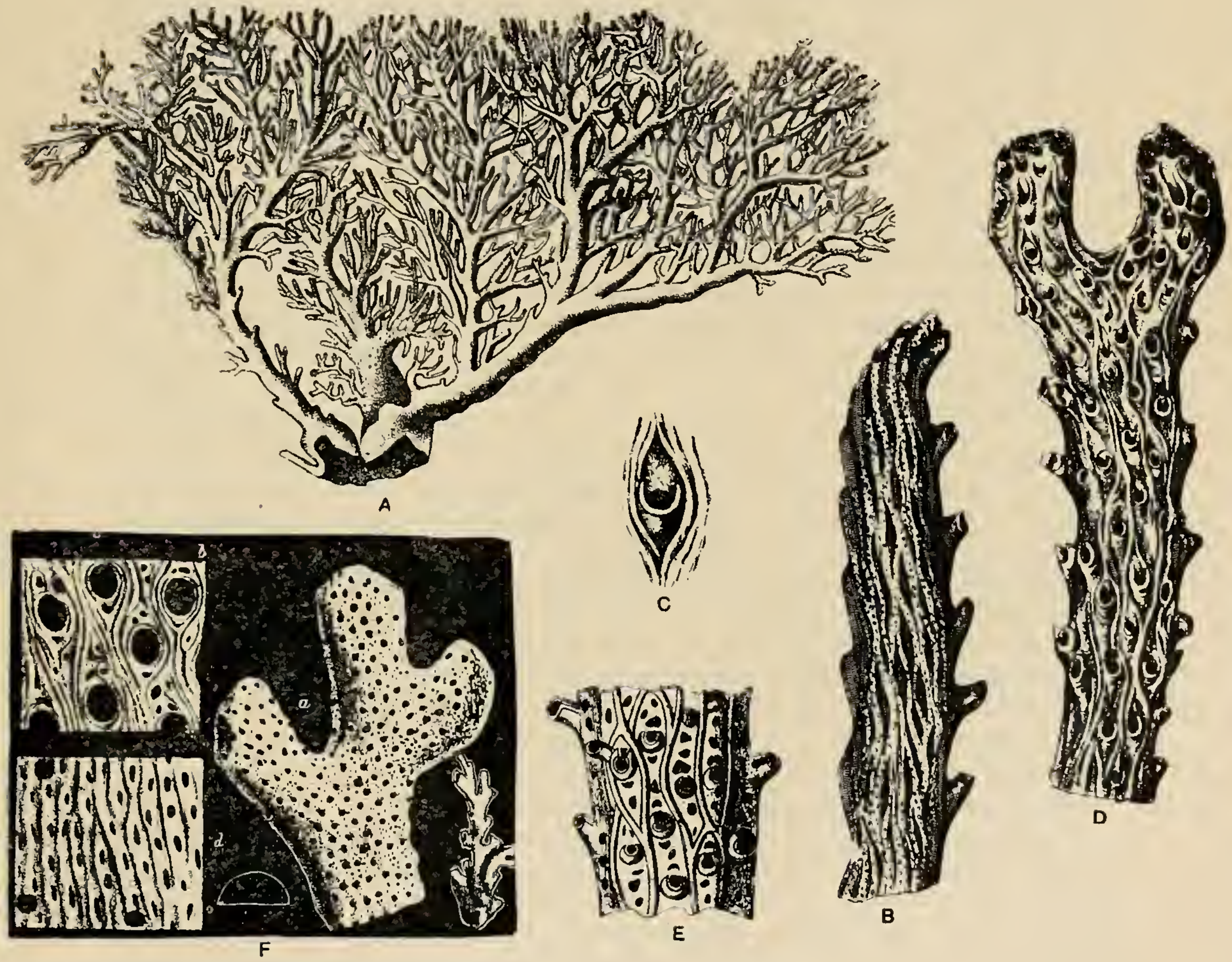


Fig. 257.—Genus *Hornera* Lamouroux, 1821.

A–E. *Hornera frondiculata* Lamouroux, 1821. A. Complete zoarium, natural size. (After Milne-Edwards, 1838.) B. Dorsal of branch, × 25. C. An aperture greatly enlarged. D. Frontal, × 25. (B–D, after Busk, 1875.) E. Another view of the frontal, × 25. (After Waters.) F. Views of the fossil form referred to the species by Busk, 1859.

| | | |
|---|---|---|
| *Measurements.*— | Diameter of the peristome | 0.12 mm. |
| | Diameter of the apertura | 0.08 mm. |
| | Distance between the peristomes | 0.40 mm. |
| | Separation of the peristomes | 0.40 mm. |

*Variations.*—The peristome is not always salient (figs. 4, 5), which reduces the diameter of the apertura (fig. 7). The frontal nervi disappear easily in fossilization (figs. 6, 7). The two large vacuoles adjacent to the apertura are very constant, but some others may appear. Generally the more vacuoles there are, the smaller they are. The apertures are grouped quite rarely in transversal lines (fig. 9).

The dorsal face is quite variable. Figure 10 illustrates the most frequent occurrence. The nervi become sometimes smaller and more numerous (fig. 11); rarely they become wider at the expense of the attenuated sulci (fig. 12).

The tangential section of the frontal always shows three or four vacuoles perforating the zoarium (fig. 13) the structure of which is composed of much crowded elements (fig. 14).

On the dorsal the vacuoles are smaller (fig. 15) and their obliquity is easily visible (fig. 16). The removal of the dorsal face by prolonged abrasion shows the usual lozenge-shaped interior; the cavity mentioned by Hennig, 1910, therefore, does not exist (fig. 17).

The vacuoles radiate in every direction and are rarely parallel. Many successive longitudinal sections are necessary, then, in order to comprehend the zoarial structure. Figure 23 shows the great complexity of the dorsal plexus, figure 24, the frontal vacuoles; figure 25, the dorsal vacuoles; while figure 26 illustrates the lamellar and squamous structure of the walls.

*Affinities.*—In the number of frontal vacuoles this species is close to *Hornera frondiculata* Lamouroux, 1821, but it differs from this recent species in its orbicular and nonelliptical orifice and in its ovicell not provided with reticulations.

It differs from *Hornera striata* Milne-Edwards, 1836, in having more than two frontal vacuoles and in its dorsal vacuoles being often larger.

It differs from *Hornera porosa* Stoliczka, 1862, in its much smaller dorsal vacuoles and in its orbicular and nonelliptical orifice.

This species is found in all Jacksonian deep-water localities.

*Occurrence.*—Middle Jacksonian: Wilmington, North Carolina, (very common); 3¼ miles south of Perry, Georgia (common); Baldock, Barnwell County, South Carolina (rare); 18 miles west of Wrightsville, Johnson County, Georgia (common); 12 miles southeast of Marshallville, Georgia (very common); 17 miles northeast of Hawkinsville, Georgia (common); 1½ miles southeast of Lilly, Dooly County, Georgia (very common); 3½ miles north of Grovania, Georgia; one-half mile southeast of Georgia Kaolin Co. mine, Twiggs County, Georgia (common).

Upper Jacksonian (Ocala limestone): Old factory, about 1½ miles above Bainbridge, Georgia (very rare); Alachua, Florida (common); west bank Sepulga River, Escambia County, Alabama (very common).

*Cotypes.*—Cat. Nos. 65242, 65312, U.S.N.M.

### HORNERA RETERAMAE, new species.

Plate 144, figs. 1–8.

*Description.*—The zoarium is large, with *reticulated branches*, the fenestrae of which are elongated and fusiform. The tubes are invisible exteriorly; they bear two vacuoles adjacent to the peristome and a single sulcus of little depth. The peristome is little salient and orbicular. The dorsal bears longitudinal sulci of little depth and very large vacuoles; the nervi are wide.

| | | |
|---|---|---|
| *Measurements.*— | Diameter of the peristome | 0.12 mm. |
| | Diameter of the aperture | 0.08 mm. |
| | Distance between the peristomes | 0.50 mm. |
| | Separation of the peristomes | 0.40–0.50 mm. |

*Affinities.*—This species is quite constant on the whole, and we have observed only the habitual alterations due to fossilization. It differs from *Hornera reteporacea* Milne-Edwards, 1838, in the special arrangement of the zoarial network deprived of trabeculae and in which the branches are all of the same size.

It differs from *Hornera polyporoides* in the absence of trabeculae and in the larger, zooecial dimensions.

*Occurrence.*—Middle Jacksonian (Castle Hayne limestone): Wilmington, North Carolina (rare).

*Cotypes.*—Cat. No. 65328, U.S.N.M.

### HORNERA POLYPOROIDES, new species.

Plate 144, figs. 9–13.

*Description.*—The zoarium is reticulate and formed of compressed branches joined by short and thin transverse trabeculae. The tubes are invisible exteriorly: they bear a single wide longitudinal sulcus, at the base of which are three, four, or five large vacuoles. The peristome is wide, little salient, orbicular. On the dorsal the nervi are narrow, the sulci wide and deep, and the vacuoles large.

| | | |
|---|---|---|
| *Measurements.*— | Diameter of the peristome | 0.10 mm. |
| | Diameter of the aperture | 0.06 mm. |
| | Distance between the peristomes | 0.38–0.40 mm. |

*Variations.*—The number of frontal vacuoles is quite variable according to the form of the branches. The dorsal vacuoles are often smaller when the sulci are more numerous (fig. 12).

*Affinities.*—In its zoarium, this species resembles *Hornera reteporacea* Milne-Edwards, 1838, but the American species differs in its more numerous frontal vacuoles, in its smaller dorsal vacuoles, and in the absence of two large triangular vacuoles adjacent to the peristome.

It differs from *Hornera reteramae* in its zoarium formed of branches joined by narrow trabeculae and in the very great irregularity of the fenestrae.

*Occurrence.*—Lower Jacksonian (Moodys marl): Jackson, Mississippi (common).

Middle Jacksonian (Castle Hayne limestone): Wilmington, North Carolina (common).

*Cotypes.*—Cat. No. 65329, U.S.N.M.

### HORNERA TENUIRAMA, new species.

Plate 144, figs. 14–23.

*Description.*—The zoarium is formed of *small rami*, round, and much branched, on which the zooecia leave little place for the dorsal. The tubes are invisible exteriorly; they bear two or three longitudinal sulci, at the base of which there are two or three vacuoles. The peristome is somewhat salient, thick, orbicular. The dorsal is very narrow; it bears some longitudinal sulci with vacuoles of the same size as the frontal vacuoles.

| | | |
|---|---|---|
| *Measurements.*— | Diameter of the peristome | 0.10–0.12 mm. |
| | Diameter of the aperture | 0.06 mm. |
| | Distance between the peristomes | 0.40 mm. |

*Variations and affinities.*—In the frequent annular arrangement of the peristomes, this species much resembles *Hornera subannulata* Philippi, 1843, and *H. hippolyta* Defrance, 1831. It differs from them in the considerable reduction of the dorsal, which is extremely narrow and which is not always easy to discern.

*Occurrence.*—Middle Jacksonian (Castle Hayne limestone): Wilmington, North Carolina (very common).

*Cotypes.*—Cat. No. 65330, U.S.N.M.

### HORNERA TUBEROSA, new species.

Plate 145, figs. 1–3.

*Description.*—The zoarium is erect, of compressed and bifurcated branches. The tubes are invisible exteriorly; they bear a very wide, longitudinal sulcus with a single vacuole. The peristome is salient, thin, orbicular. The dorsal is convex; the longitudinal sulci are rather deep; the vacuoles are very small; the nervi are wide, convex, and bear numerous salient *tuberosities.*

*Affinities.*—This species is very well characterized by its dorsal tuberosities, this character never having been observed in any other known species. The only specimen found has been figured, but it is very characteristic.

*Occurrence.*—Upper Jacksonian (Ocala limestone): Chipola River, east of Marianna, Jackson County, Florida (very rare).

*Holotype.*—Cat. No. 65331, U.S.N.M.

### HORNERA POROSA Stoliczka, 1862.

Plate 145, figs. 4–19.

1862. *Hornera porosa* Stoliczka, Oligocene Bryozoen von Latdorf in Bernburg, Sitzungsberichte der k. Akademie der Wissenschaften Wien, vol. 45, Abth. 1, p. 79, pl. 1, fig. 3.

*Description.*—The zoarium is formed of compressed branches bearing rami almost opposite. The tubes are invisible exteriorly; they bear two oblique sulci ornamented with large vacuoles. The peristome is salient, thin, elliptical, or oval. The dorsal is very porous; the longitudinal sulci are of little depth, the nervi are wide but little convex; the vacuoles are large but of lesser dimensions than the frontal vacuoles.

| | | |
|---|---|---|
| *Measurements.*— | Diameter of the peristome | 0.10 mm. |
| | Diameter of the aperture | 0.06–0.08 mm. |
| | Distance between the peristomes | 0.50 mm. |
| | Separation of the peristomes | 0.44 mm. |

*Variations.*—The peristome is very salient (fig. 8) or scarcely projecting (fig. 10). When the frontal vacuoles are smaller (fig. 10) they are more numerous. The dorsal is exceedingly variable and it is impossible to discover the rule of variation. However, on the young branches the sulci are very narrow and the nervi very wide (fig. 14). Somewhat later the vacuoles are more visible (figs. 13, 15). Normally (fig. 12) the vacuoles are large and the nervi little salient.

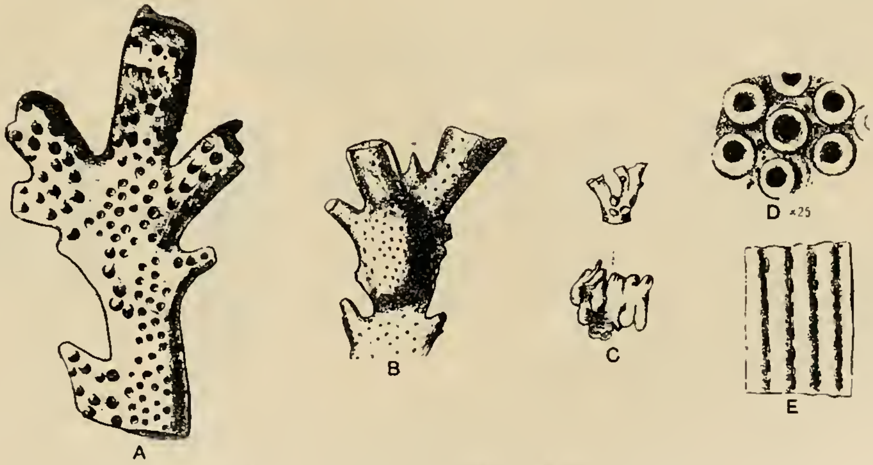


Fig. 258.—Genus *Crassohornera* Waters, 1887.

A, B. Frontal, × 12, and dorsal, × 8, of *Crassohornera* (*Ceriopora*) *arbuscula* Reuss, the latter showing the ovicell.

C–E. Views of the zoarium, natural size, and the frontal and dorsal, × 25, of *Crassohornera waipukurensis* Waters, 1887.

The dorsal vacuoles are enlarged at their extremity, for in tangential sections they appear smaller (fig. 17). As in all the species of the genus the elements are thick and crowded which makes it very difficult to obtain good thin sections (fig. 19).

The squamous and lamellar structure of the walls appear to result from the linear union of the primitive elements (fig. 18).

*Affinities.*—The species singularly resembles *Hornera frondiculata* Lamouroux, 1821, in the number of frontal vacuoles and in the elliptical form of the peristomes. It differs from it, however, in a smaller number of longitudinal sulci on the dorsal, and in the larger vacuoles. We unfortunately have not yet discovered the ovicell, so that we are not able to confirm the identity of this species with that of Lamouroux, as noted by Jelly in 1889.

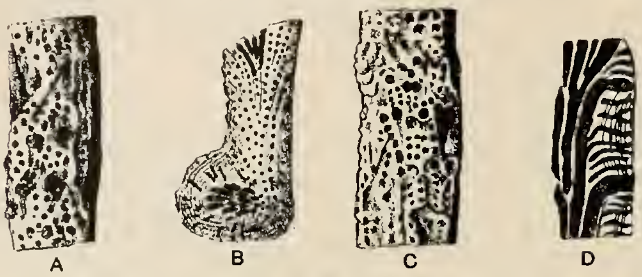


Fig. 259.—Genus *Siphodictyum* Lonsdale, 1849.

A–D. *Siphodictyum gracile* Lonsdale, 1849. A. Frontal of branch, × 8, from the Cretaceous of England. B. A thin slice from a branch, × 12, showing longitudinal and transverse sections. C. Dorsal of a well preserved specimen, × 10. D. Longitudinal section, enlarged.

*Occurrence.*—Middle Jacksonian: Wilmington, North Carolina (rare); Baldock, Barnwell County, South Carolina (very rare); Rich Hill, 5¼ miles southeast of Knoxville, Crawford County, Georgia (very rare). Vicksburgian (Marianna limestone): One mile north of Monroeville, Alabama (very abundant).

*Geological distribution.*—Lower Oligocene (Latdorfian) of Germany.

*Plesiotypes.*—Cat. Nos. 65332, 65478, 65479, U.S.N.M.

### Genus CRASSOHORNERA Waters, 1887.

1887. *Crassohornera* Waters, Tertiary, Cyclostomatous Bryozoa from New Zealand, Quarterly Journal Geological Society, London, vol. 43, p. 349.

Horneridae in which there are no frontal sulci.

*Genotype.*—*Crassohornera waipukurensis* Waters, 1887.

*Range.*—Priabonian-Miocene.

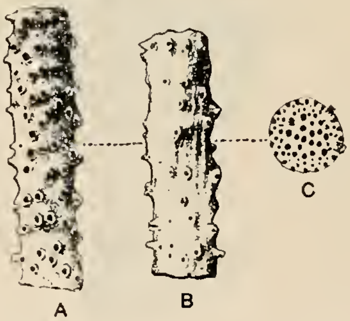


Fig. 260.—Genus *Phormopora* Marsson, 1887.

Frontal and dorsal and end views, × 16, of a branch of *Phormopora irregularis* Marsson, 1887, from the Cretaceous of the Island of Rügen. (After Marsson, 1887.)

### Genus SIPHODICTYUM Lonsdale, 1849.

1849. *Siphodictyum* Lonsdale, Notes on fossil Zoophytes, Quarterly Journal Geological Society, London, vol. 5, p. 94.

"Horneridae in which the epitheca on the reverse side is thick. The apertures are in irregular, transverse series. The maculae (=vacuoles) occur in single or double longitudinal series below the aperture. The reverse side is ornamented by ridges (=nervi), which may be reticular." (After Gregory 1899.)

*Genotype.*—*Siphodictyum gracile* Lonsdale, 1849. Aptian.

The ovicell is unknown, but the zoarial structure is certainly that of the Horneridae.

### Genus PHORMOPORA Marsson, 1887.

1887. *Phormopora* Marsson, Bryozoen der schreibkreide der Insel Rügen, Paleontologische Abhandlungen, vol. 4, p. 32.

Horneridae with cylindrical, dichotomous branches. The apertures are scattered irregularly over the obverse face and not in regular transverse rows. The reverse face is marked by small or well-developed tubuli.

*Genotype.—Phormopora irregularis* Marsson, 1887. Senonian. (After Gregory, 1899.)

The section published by Marsson appears to indicate the lamellar and squamous structure of the Horneridae, but the ovicell is unknown.

## Family FRONDIPORIDAE Busk, 1875.

1875. *Frondiporidae* Busk, Catalogue of Marine Polyzoa in the collection of the British Museum, pt. 3, Cyclostomata, vol. 8, p. 137.

The larva is elongated; the orifice of the palleal cavity and the orifice of the sack do not occupy exactly the two poles of the embryo. The ovicell is arranged between the fascicles and is traversed by isolated tubes. The tubes are cylindrical.

The genera belonging to this family are: *Frondipora* Imperato, 1599. *Telopora*, new genus, and perhaps the following forms: *Fasciculipora* D'Orbigny, 1846, *Discofascigera* D'Orbigny, 1853, and *Apsendesia* Lamouroux, 1821.

The zoarium is formed of tubes arranged in fascicles. All the tubes have the same diameter throughout; they are not thinner at the base as in the zoarial forms *Entalopora*, *Idmonea*, etc. In transverse section the tubes of the center have therefore the same diameter as those of the periphery, as in the zoarial forms, *Heteropora* and *Ceriopora*. There are therefore cylindrical tubes arranged in bundles. They put forth new tubes by ramification. The basal lamella is very thick and is formed by the exterior wall of long basal tubes without polypide which ramify at nearly the half of their length. Each basal tube takes its origin on the interior of the zoarium which is just the contrary to what is observed on the basal lamella of forms with conical tubes.

The Frondiporidae are extremely rare in our American Tertiary formations. They appear to have disappeared from our recent American waters; neither Smitt, Robertson, nor Osborn cites a single species of the family. On the contrary, the specimens of this family swarm in the Mediterranean.

### Genus FRONDIPORA Imperato, 1599.

1599. *Frondipora* Imperato, Dell Historia naturale, p. 631.

"*Frondipora* has the ovicell across the anterior surface of a branch, not much raised, and the oeciostome, about 0.12 mm. wide, with the lower edge straight, also is but little raised, and is not attached to a group of zooecia." (Waters.) The fascicles are arranged only on the anterior face of the zoarium.

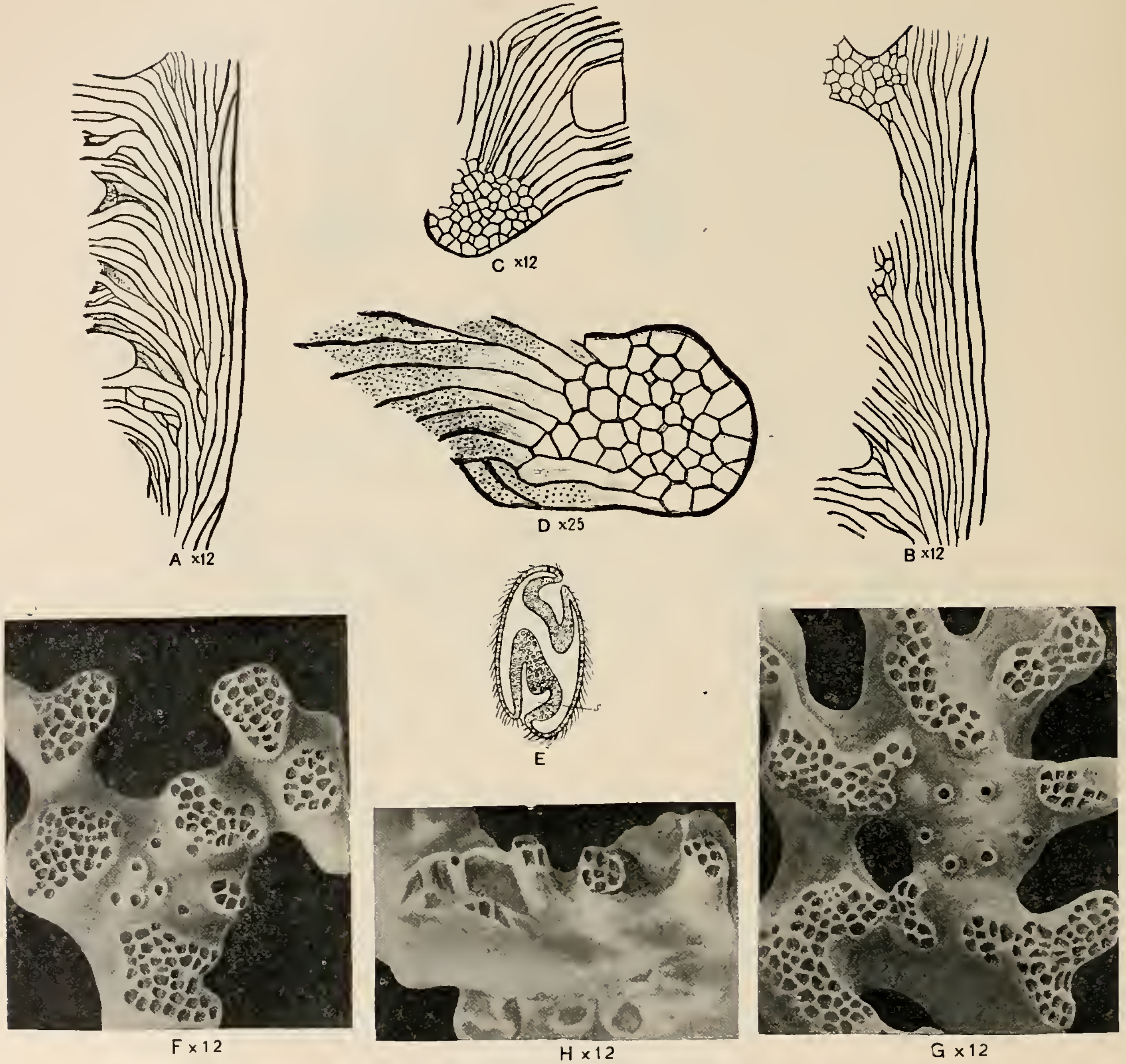


Fig. 261.—Family Frondiporidae Busk, 1875.

A–H. *Frondipora verrucosa* Lamouroux, 1821. A, B. Two longitudinal thin sections of a branch, × 12. C. Transverse section, × 12, through an ovicelled branch showing the position of the ovicell between the fascicles. D. Transverse section through a branch, × 25, and cutting a fascicle longitudinally. E. Larva of *Frondipora* showing internal sac (*s*). (After Barrois, 1882.) F, G. Ovicelled branches, × 12. H. Transversal section though an ovicell, × 12, showing that the isolated tubes form the pillars supporting the upper walls.

*Genotype.—Frondipora verrucosa* Lamouroux, 1821.

*Range.*—Priabonian-Recent.

The zoarial variations are very great. Generally the zoarium forms true bushy masses which assume the most fantastic and elegant forms. Our fossil specimens are only the insignificant remains of such zoaria.

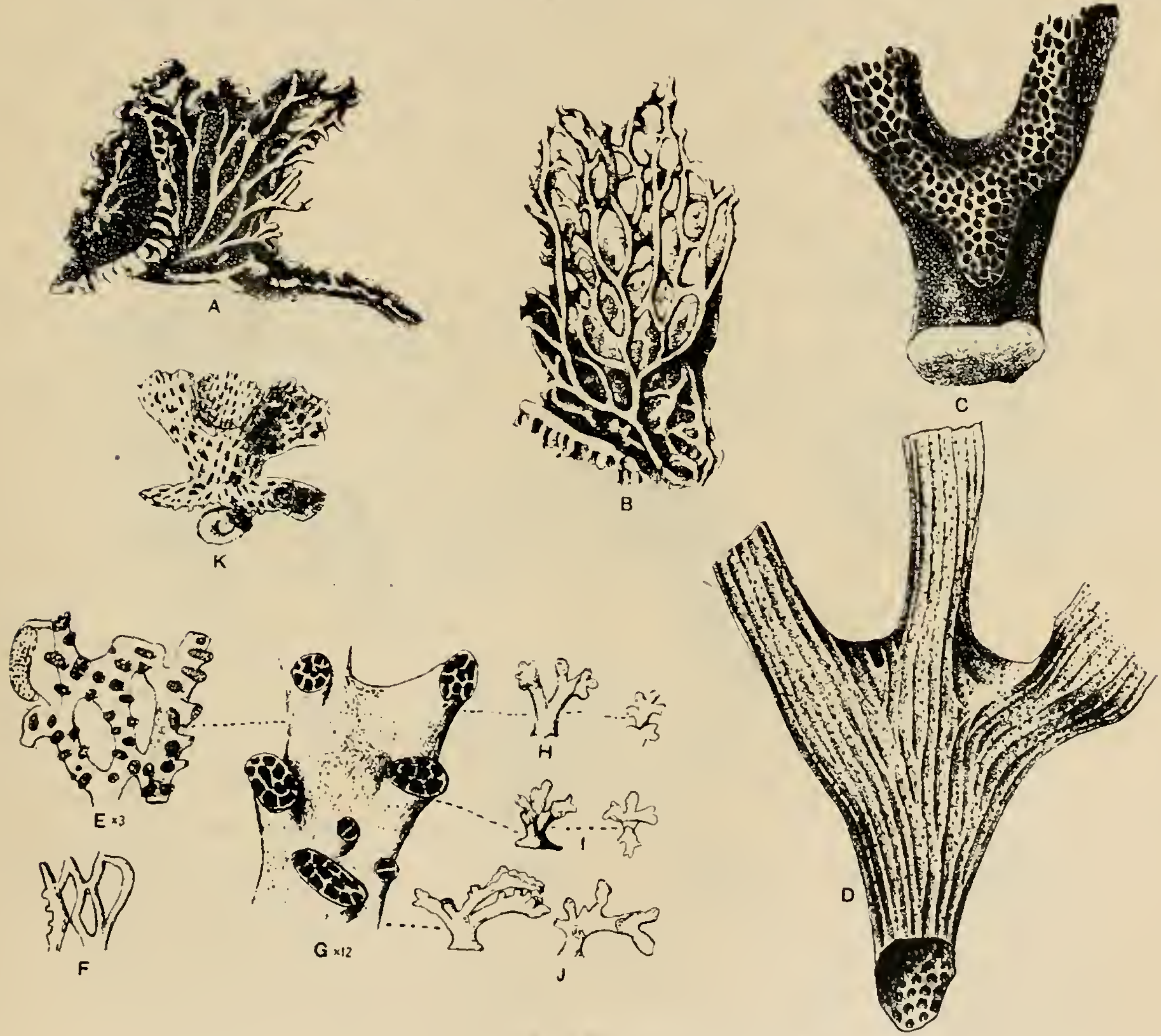


Fig. 262.—Genus *Frondipora* Imperato, 1599.

A–K. *Frondipora verrucosa* Lamouroux, 1821. A, B. Zoaria, natural size. C. Frontal of branch, × 25, showing fascicles confluent. D. Dorsal, × 25. (A–D, after Busk, 1875.) E. Frontal of branch, × 3. F. Dorsal, × 1½. G. Frontal of a young branch, × 12. H–J. Young specimens, natural size. K. Colony, natural size, growing on a shell. (E–K, after Waters, 1879.)

### FRONDIPORA LAEVIGATA, new species.

Plate 147, figs. 15–27.

*Description.*—The zoarium is formed of compressed and dichotomous branches. The fascicles are formed of two to five tubes; they are little salient and arranged in compact groups or in linear series. The tubes are distinct, separated by a furrow; the peristome is thin, orbicular, or polygonal. The posterior face is convex, striated longitudinally by the tubes. The interfascicular spaces are *smooth.*

*Variations.*—The arrangement of the fascicles is quite variable; there is not one which resembles another. They are scattered or in alternate lateral, pluriserial, or monoserial series, very salient or hardly salient. There are never any isolated tubes between the fascicles, as in *Frondipora interporosa.*

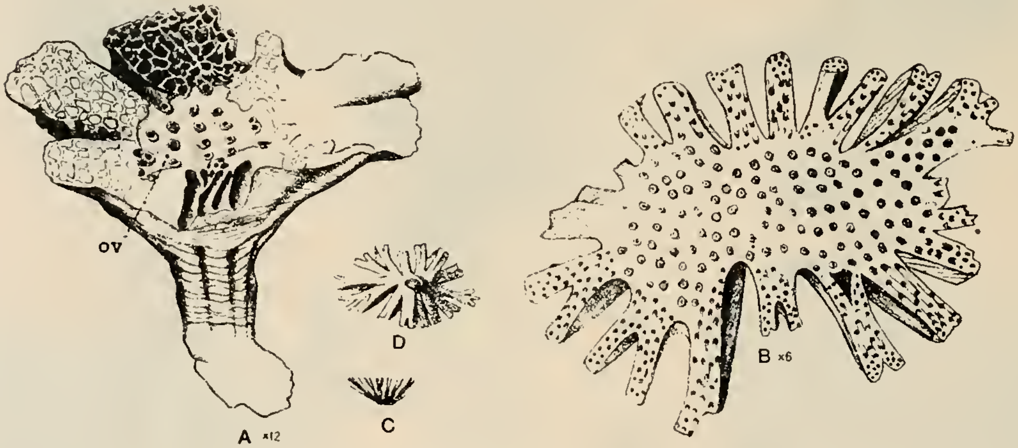


Fig. 263.—*Telopora,* new genus.

A. *Telopora* (*Supercytis*) *watersi* Harmer, 1915. View of ovicelled zoarium, × 12.
B–D. *Telopora* (*Supercytis*) *digitata* Waters, 1884. B. Top of view of zoarium, × 6. C. Side view, natural size. D. Basal view, × 2.

In transverse section (fig. 26) all the tubes are of the same diameter. Between them there are some small pores which appear to be new tubes. The latter promptly attain their normal diameter, as can be seen in longitudinal section (figs. 24, 25). The peristomie of the tubes makes a more or less acute angle with their longitudinal axis (figs. 24, 25). There are sometimes diaphragms in the tubes.

*Occurrence.*—Middle Jacksonian (Castle Hayne limestone): Wilmington, North Carolina (rare).

*Cotypes.*—Cat. No. 65436, U.S.N.M.

### FRONDIPORA INTERPOROSA, new species.

Plate 148, figs. 20–23.

We have only collected five specimens of this species. It differs from *Frondipora laevigata* in the presence of isolated tubes between the fascicles.

*Occurrence.*—Middle Jacksonian: Near Lenuds Ferry, South Carolina.

*Cotypes.*—Cat. No. 65451, U.S.N.M.

## TELOPORA, new genus.

Greek: *telos*, end, in allusion to the position of the ovicell.

Ovicell at the end of the erect colony spreading over the whole width.

*Genotype.—Telopora* (*Supercytis*) *watersi* Harmer, 1915.

*Range.*—Miocene-Recent.

*Telopora* (*Supercytis*) *digitata* Waters, 1884, belongs to this genus.

This genus presents the greatest zoarial analogy with *Supercytis* D'Orbigny, 1852, but the ovicell is totally different.

### TELOPORA ? PATENS, new species.

Plate 148, figs. 24–27.

*Description.*—The zoarium is supported on a spreading base attached to algae: it is formed of wide divergent branches, little erect, irregularly branched. The anterior or cellular face is covered by the oblique orifices of the tubes. The posterior face bears sulci with large pores at the base.

*Affinities.*—This species is not a *Telopora*, for this genus does not present sulci on the dorsal. The figured specimen only has been discovered. We have thought that it was useless to form a new genus for a nonovicelled specimen of which we are unable to make a section.

*Occurrence.* — Middle Jacksonian (Castle Hayne limestone): Wilmington, North Carolina (rare).

*Holotype.*—Cat. No. 65452, U.S.N.M.

### Forma FASCICULIPORA D'Orbigny, 1846.

1846. *Fasciculipora* D'Orbigny, Voyage dans l'Amerique-Méridionale, vol. 5, pt. 4, p. 20.

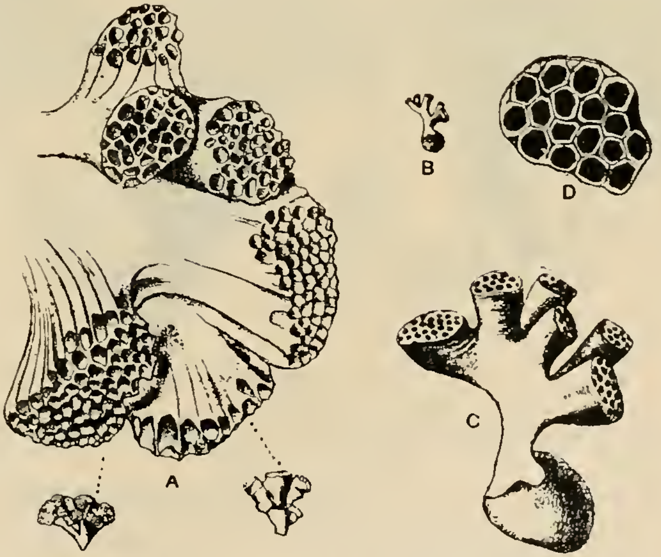


Fig 264.—Genus *Fasciculipora* D'Orbigny, 1846.

A–D. *Fasciculipora ramosa* D'Orbigny, 1846. A. The fungiform zoarium, natural size and enlarged (after Busk, 1875). B–D. D'Orbigny's original figures of the species, representing the zoarium, natural side and enlarged, and the zooecial surface enlarged. Recent. South Patagonia.

"Zoarium with long branches, which may be simple or branch into a dendroid stipitate zoarium. The capitulum is simple or lobed. The branches are cylindrical and may be clavate. The sides may be covered by a thick epizoarium, or marked by interzooecial striae or grooves." (After Gregory.)

*Genotype.*—*Fasciculipora ramosa* D'Orbigny, 1846.

*Range.*—Neocomian-Recent.

This genus differs from *Frondipora* in its long fascicles not arranged on a single side of the zoarium. The ovicell has never been discovered. It is therefore convenient to consider it only as a zoarial form.

### FASCICULIPORA SURCULIFERA, new species.

Plate 148, figs. 14–19.

We have discovered only the two small specimens figured; these are two small branches of which we have not been able to make a section.

*Occurrence.*—Upper Jacksonian (Ocala limestone): Alachua, Florida (very rare).

*Cotypes.*—Cat. No. 65450, U.S.N.M.

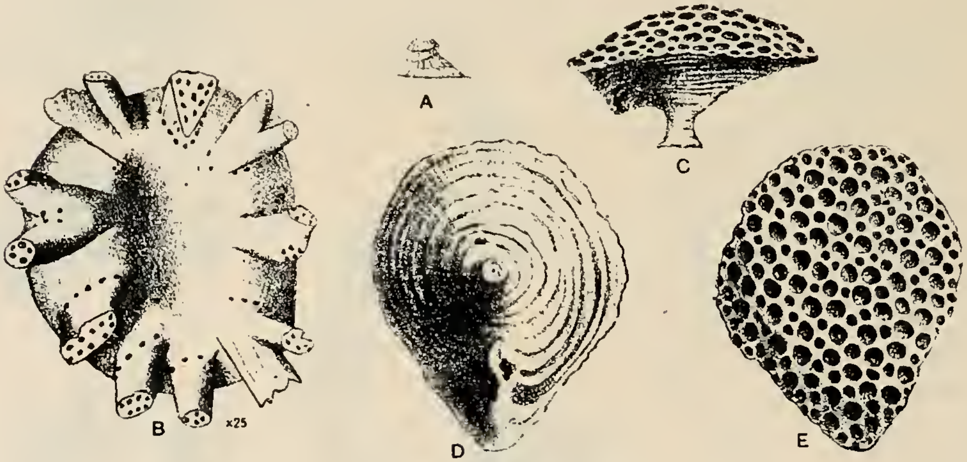


FIG. 265.—Forma *Discofascigera* D'Orbigny, 1852.

A, B. Views of *Discofascigera* (*Defrancia*) *exaltata* Waters, 1884, natural size and × 25.
C, D, E. Various aspects enlarged of a zoarium of *Discofascigera ligeriensis* D'Orbigny, 1852.

### Forma DISCOFASCIGERA D'Orbigny, 1852.

1852. *Discofascigera* D'ORBIGNY, Paleontologie française Terrain Crétacé, Bryozoaires, vol. 5, p. 674.

The zoarium consists of a single, unbranched bundle of zooecia; the zooecia are short, and the zoarium is fungiform, consisting of a short stalk which rapidly expands above into a circular or subcircular disk, with a convex upper surface. Apertures crowded and all on the upper surface of the zoarium: they are either irregular or subquincuncial in arrangement. (After Gregory, 1909).

*Genotype.*—*Discofascigera ligeriensis* D'Orbigny, 1852.

*Range.*—Albian-Miocene.

The Tertiary species cited by Gregory are:

*Discofascigera* (*Defrancia*) *exaltata* Waters, 1884. Miocene of Australia.
*Discofascigera* (*Defrancia*) *brendolensis* Waters, 1892. Priabonian.
*Discofascigera* (*Discotubigera*) *actinoides* Manzoni, 1878. Miocene of Europe.
*Discofascigera* (*Supercytis*) *digitata* MacGillivray, 1895. (=*Telopora*.)

All these species are extremely rare. Their ovicells have never been observed. We therefore consider D'Orbigny's genus as amended by Gregory, as a zoarial form and we describe it here for convenience in determination. There is no evidence to show that it is a member of the Frondiporidae.

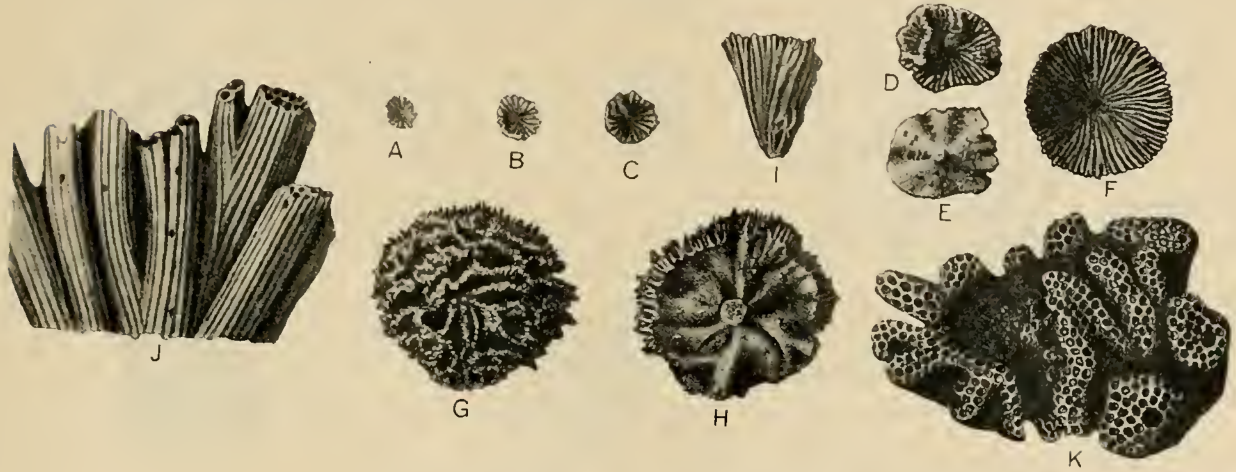


Fig. 266.—Forma *Apsendesia* Lamouroux, 1821.

A–K. *Apsendesia cristata* Lamouroux, 1821. A–D. Top views of four zoaria, natural size. E. Basal view of specimen D. F. Young zoarium, natural size. G, H. Top and basal views of a well-developed example, natural size. I, J. Elevated branches, natural size, and × 8. K. The summit of the same branches, × 8.

### Forma APSENDESIA Lamouroux, 1821.

1821. *Apsendesia* Lamouroux, Exposition méthodique des genres de l'ordre des Polypiers, avec leur description et celle des principales espèces, p. 81.

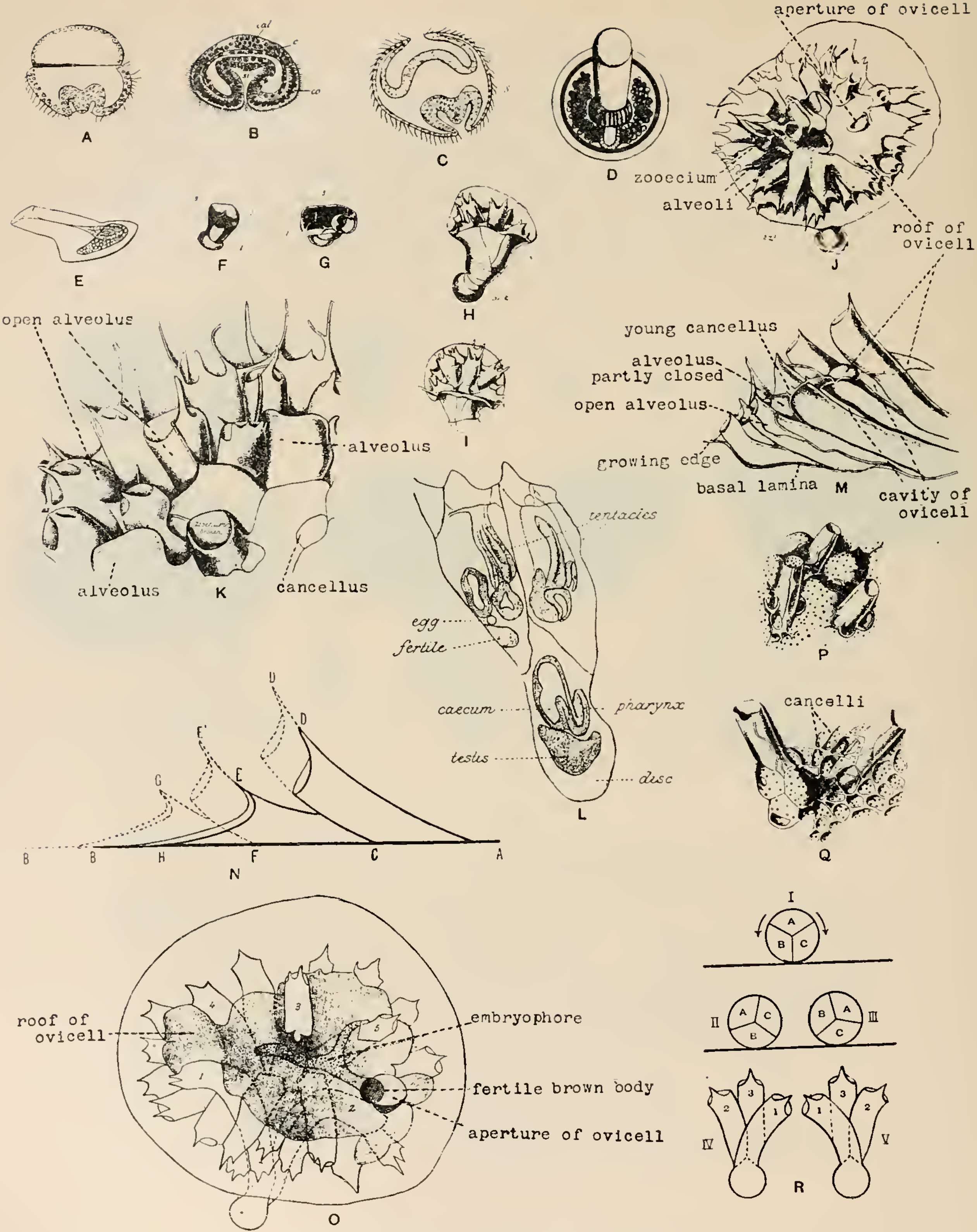
"Fascigeridae with a massive zoarium, which develops from a small cup-shaped disk. The zooecial groups in the adult are long, and form irregularly sinuous series, which may be so crowded that the zoarium becomes massive. Apertures all on the ends of the zooecial bundles." (After Gregory, 1909.)

*Genotype.*—*Apsendesia cristata* Lamouroux, 1821.
*Range.*—Jurassic-Cretaceous.

This is a zoarial form in which the ovicell has not yet been discovered.

### Subdivision RECTANGULATA Waters, 1887.

The ovicell is developed perpendicularly to the terminal zooecial axis between the peristomes and not between the tubes.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alveolus
alveolus
K
cancellus
I
young cancellus
alveolus partly closed
open alveolus
growing edge
basal lamina
M
cavity of ovicell
tentacles
egg
fertile
caecum
pharynx
testis
disc
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III
roof of ovicell
embryophore
fertile brown body
aperture of ovicell
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Fig. 267.—Family Lichenoporidae Smitt, 1866.

FIG. 267.—Family Lichenoporidae Smitt, 1866.

A. Embryo of *Lichenopora* at the time of the division of the ectoderm into two distinct halves of which one is destined to be recovered.

B. Embryo of *Lichenopora hispida* Fleming, 1828. Meridian section of an embryo more advanced in its development than the preceding one. The internal sac (*si*) the coronna (*co*) the thickness of the calotte (*cal*) and the palleal epithelum (*c*) are differentiated at the cost of the external cellular layer. The internal cellular layer forms a lining which continues to the cavity of the embryo. (After Calvet, 1900.)

C. Larva of *Lichenopora;* it is flat and not elongated as in the other Cyclostomata (*s*, internal sac). The calotte is covered by the mantle, a feature which does not exist in the larva of the Cheilostomata. (After Barrois, 1886.)

D, E. Protoecium of *Lichenopora* seen from the front and in profile. (After Barrois, 1886.)

F–R. *Lichenopora verrucosa* Fabricius. F–I. Drawings showing development of the ancestrula and formation of the zoarium.

J. Colony in which the roof of the ovicell is developing. The aperture of the ovicell is not yet completely formed. The proximal edge of the basal lamina has nearly reached the protoecium.

K. Part of the growing edge of an adult colony, showing the way in which new zooecia are formed and representing varions stages in the development of the alveoli.

L. Horizontal section of a colony consisting of three complete zooecia only and showing the anatomical structure.

M. Thick radial section of part of an old colony showing the relations of the ovicell to the zooecia.

N. Diagram of the growth of the margin of the colony. The thick lines represent two young zooecia and part of the basal lamina as they would be seen in the radial section, and the dotted lines represent the condition of the corresponding parts after a certain amount of growth has taken place; ACHB is the basal lamina. The zooecium whose point is marked D has its upper end free, even in the earlier condition, while that marked E is still incomplete on its distal side (fig. K).

O. Entire colony stained and mounted in Canada balsam. The shaded part shows how much of the ovicell is completely roofed. The alveoli which are still unroofed are not specially indicated. The ovicell has an aperture, at the base of which is the fertile brown body (primary embryo). Parts of the zooecia which are seen either through other zooecia or through the roof of the ovicell are indicated by dotted lines. The colony is left-handed. Z2 is occluded and was obviously fertile and would hardly have been visible at all in a dry preparation. The embryophore is that part of the ovicell in which the secondary embryos are developed.

P. Zooecia from an old colony. The alveoli are still distinctly visible and the cancelli are commencing in the interalveolar grooves or at the base of the zooecia. The left hand zooecium is closed by a porous calcareous cap.

Q. Two zooecia from a very old colony, with secondary thickening. The porous roof of the ovicell is seen at the bottom of a set of honey comb-like spaces, the so-called "cancelli"; some of these are covering the bases of the zooecia, and in the left hand zooecium these are entirely or partially roofed. Two of the blister-like swellings thus formed have part of their roof still uncalcified.

R. Diagram to explain the difference between "right-handed" (dextral) and "left-handed" (sinistral) colonies. (F–R, after Harmer, 1896.)

## Family LICHENOPORIDAE Smitt, 1866.

*Anatomical bibliography.*—1884. WATERS, Closure of the Cyclostomatous Bryozoa, Journal Linnean Society, Zoology, vol. 17, p. 403, pl. 17, figs. 1, 6, 7, 8.—1886. BARROIS Mémoire sur la Metamorphose de quelques Bryozoaires, Bibliothèque de l'Ecole des Hautes etudes; Section des Sciences naturelles, vol. 32, No. 5, pp. 42, 94, pl. 3, fig. 30; pl. 4, fig. 28.—1888. WATERS, On the ovicells of some Lichenoporidae, Journal Linnean Society, Zoology, vol. 20, pp. 280–285, pl. 15.—1896. HARMER, On the development of Lichenopora verrucaria Fabricius, Quarterly Journal Microscopical Science, new ser., vol. 39, pp. 71–144, pls. 7–10.—1914. WATERS, The Marine Fauna of Zanzibar and British East Africa, Zoological Society of London, p. 836.

The larva is very large and flattened. It is not elongated as in the other cyclostomes. The ovicell is lobate; it covers the zoarial center or it is placed between the fascicles. The oeciostome is very large. The zooecia are joined in radiating fascicles. The cancelli are placed at the zoarial center and between the fascicles.

The cancelli are adventitious tubes which seem peculiar to the Lichenoporidae. They are garnished with spinules and are closed by a finely perforated calcareous lamella. Their structure is constant for each species and characterizes the species. Their function is unknown.

Generally the tubes are terminated by a long, very fragile point called the *galea* (=visor) by Jullien. The part which it protects forms a trap for diatoms.

The first tubes issued from the ancestrula are not parallel to it. This obliquity explains their peculiar spindle arrangement in the median sections where their projection on the flat section is alone visible. This arrangement does not exist in the Tubuliporidae.

The ovicells often cover the cancelli; but in the same species the contrary may occur and the cancelli may cover the ovicell.

The tubes never creep on the basal lamella. They bend upward immediately after their formation. The abrasion of the lower face of the zoaria offers, therefore, the aspect of a transverse section in the tubes.

### Genus LICHENOPORA Defrance, 1823.

1823. *Lichenopora* DEFRANCE, Dictionnaire des Sciences naturelles, vol. 26, p. 256.

The zoarium is orbicular, simple or composite. The fascicles are mono- or pluri-serial. The ovicell is placed in the center of the zoarium. Its oeciostome is larger than the tubes.

*Genotype.*—*Lichenopora* (*Discopora*) *hispida* Fleming, 1828.

*Range.*—Neocomian-Recent.

This genus has been dismembered by the paleontologists into many other genera according to the zoarial variations. Text figure 269 gives a summary of the genera as recognized by Gregory, 1899. The zoologists have never recognized them because the same species is capable of taking a number of zoarial forms and because these zoarial forms do not correspond to special functions.

The Lichenoporidae are very fragile. They are easily broken. On the fossils the visors are rarely preserved in their entirety. The determination of the species, even the recent ones, presents therefore much difficulty. As the oeciostomes and the cancelli can only give constant characters, we have given a summary in figure 256 of our knowledge of these important organs. On the fossils we have not yet discovered the complete oeciostome and this absence of character much weakens the determinations.

The first two zooecia issued from the ancestrula determines the direction of the tubes in a given section. We call them directrices and they are always of a smaller diameter than the other tubes.

### LICHENOPORA BOLETIFORMIS Reuss, 1869.

Plate 130, figs. 1–11.

1869. *Radiopora boletiformis* Reuss, Paläontologische Studien über die älteren Tertiärschichten der Alpen, Denkschriften der k. Akademie der Wissenschaften, Wien, vol. 29, p. 81, pl. 28, fig. 7 (1) (not *Tecticavea boletiformis* D'Orbigny, 1854, nor *Lichenopora boletiformis* Waters, 1884.)

*Description.*—The zoarium is free and reposes on the substratum only by a thin peduncle. It is formed of many lamellae superposed. Each lamella contains many confluent subcolonies. The basal lamella is thick and striated concentrically. The subcolonies are orbicular or elliptical with a large central area. The fascicles are little salient, short, biserial or triserial. The tubes are small and deprived of visor. The cancelli are larger than the tubes; they are polygonal and their walls are thin.

| | | |
|---|---|---|
| *Measurements.*— | Diameter of the tubes | 0.16 mm. |
| | Diameter of the cancelli | 0.20 mm. |
| | Greatest dimension of the zoaria | 1 cm. |

*Variations.*—The fascicles become much attenuated and the zoaria have then much resemblance to *Ceriopora* (fig. 6). The zoarium has no fixed form, but a very convex ensemble is the most frequent. Each subcolony has no special basal lamella. The tubes are polygonal (figs. 7, 8) in the sections but they are round in the broken portion. The spinules of the cancelli (fig. 8) are small, numerous, and arranged in longitudinal series.

The median sections vary according to place where they are made. In a section (fig. 10) perpendicular to the fascicles the tubes are seen from the front. In section (fig. 11) practically within a fascicle the tubes appear in their length and parallel to each other.

*Affinities.*—On account of its multiserial fascicles this species is very close to *Lichenopora mediterranea* Michelin, 1848, and to *Lichenopora verrucosa* Philippi, 1843. It is distinguished from them by the greater micrometric and zoarial dimensions.

*Occurrence.*—Middle Jacksonian: Wilmington, North Carolina (common); Eutaw Springs, South Carolina (very common); Baldock, Barnwell County, South Carolina (rare).

*Geological distribution.*—Priabonian of the Vicentin (Reuss).

*Plesiotypes.*—Cat. No. 65453, U.S.N.M.

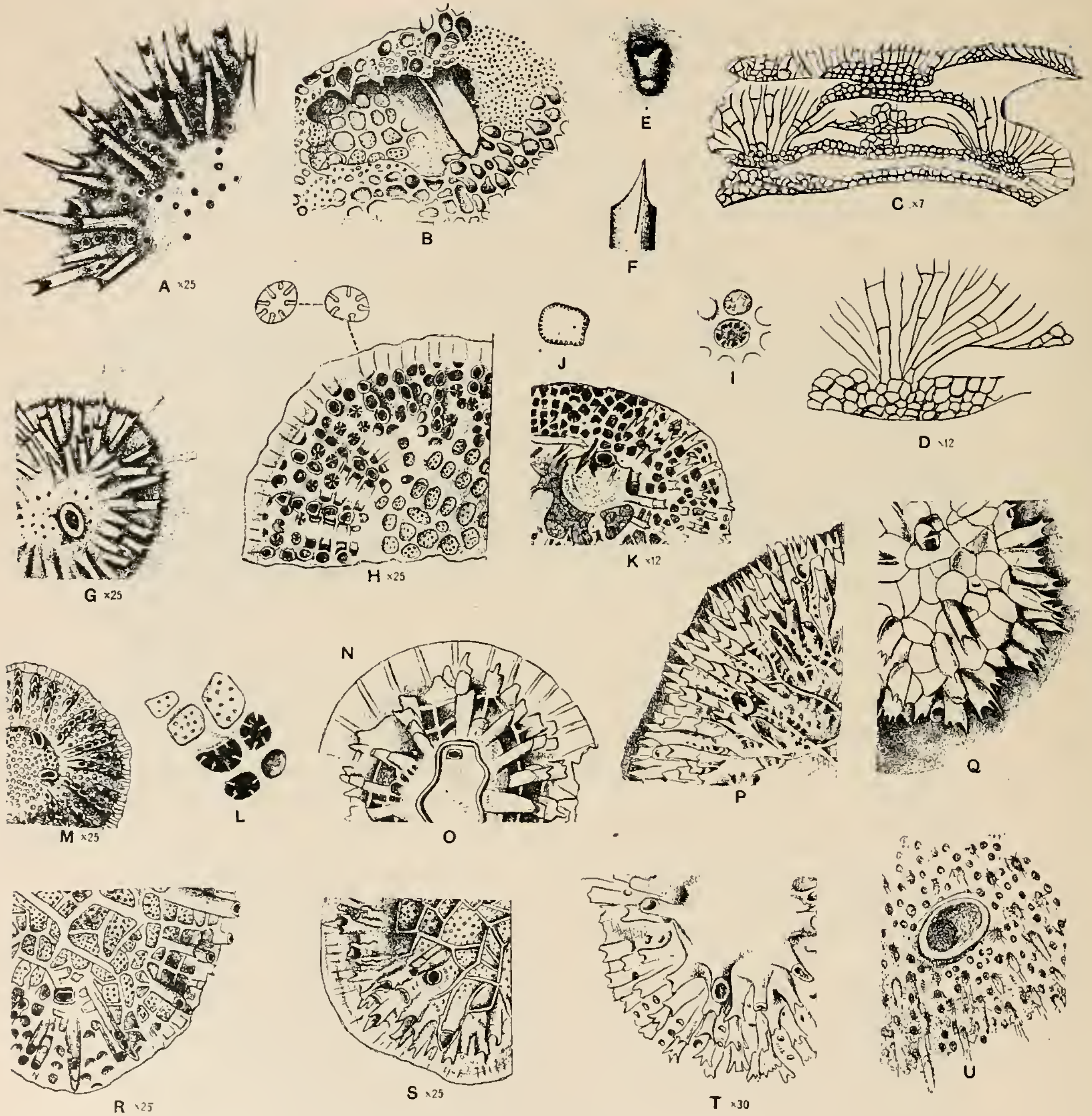
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Fig. 268.—Genus *Lichenopora* Defrance, 1823.

FIG. 268.—Genus *Lichenopora* Defrance, 1823.

A. Fragment of the zoarium, × 25, of *Lichenopora hispida* Fleming, 1828, showing the cancelli and the tubes provided with the visor. (After Hincks, 1880.)

B. Ovicell of *Lichenopora bullata* MacGillivray, 1886, superposed upon cancelli. (After MacGillivray, 1889.)

C, D. Longitudinal section, × 7, and × 12 of *Lichenopora boletiformis* Reuss, 1869, a fossil from Aldinga, Australia, showing tabulae irregularly placed. (After Waters, 1884.)

E. Protoecium of *Lichenopora hispida* Fleming, 1828.

F. A single cell of *Lichenopora verrucaria* Fabricius, 1780, showing the acuminate margin. (E, F, after Hincks, 1880.)

G–U. Figures showing oeciostomes and spinules of the cancelli. G. *Lichenopora hispida* Fleming, 1828. (After Hincks, 1880.) H. *Lichenopora holdsworthi* Busk, 1875. (After Waters, 1888.) I. *Lichenopora mediterranea* Blainville, 1834. (After Harmer, 1915.) J, K. *Lichenopora echinata* MacGillivray, 1883. (After Waters, 1888.) L, M. *Lichenopora radiata* Audouin, 1826. (After Hincks, 1880, and Waters, 1879.) In L the cancelli to the left are closed by a delicate calcareous cover perforated with about two to ten holes and to the right they show spines with globular terminations. N, O. *Lichenopora novae-zelandiae* Busk, 1875. (After Harmer, 1915.) P, Q. *Lichenopora verrucaria* Fabricius, 1780. (After Smitt, 1866, and Harmer, 1896.) R. *Lichenopora reticulata* MacGillivray, 1883. (After Waters, 1894.) S. *Lichenopora venabulum* Jullien, 1888. (After Waters, 1887.) T. *Lichenopora fimbriata* Busk, 1875. (After Busk.) U. *Lichenopora capillata* Kirkpatrick, 1890. (After Kirkpatrick.)

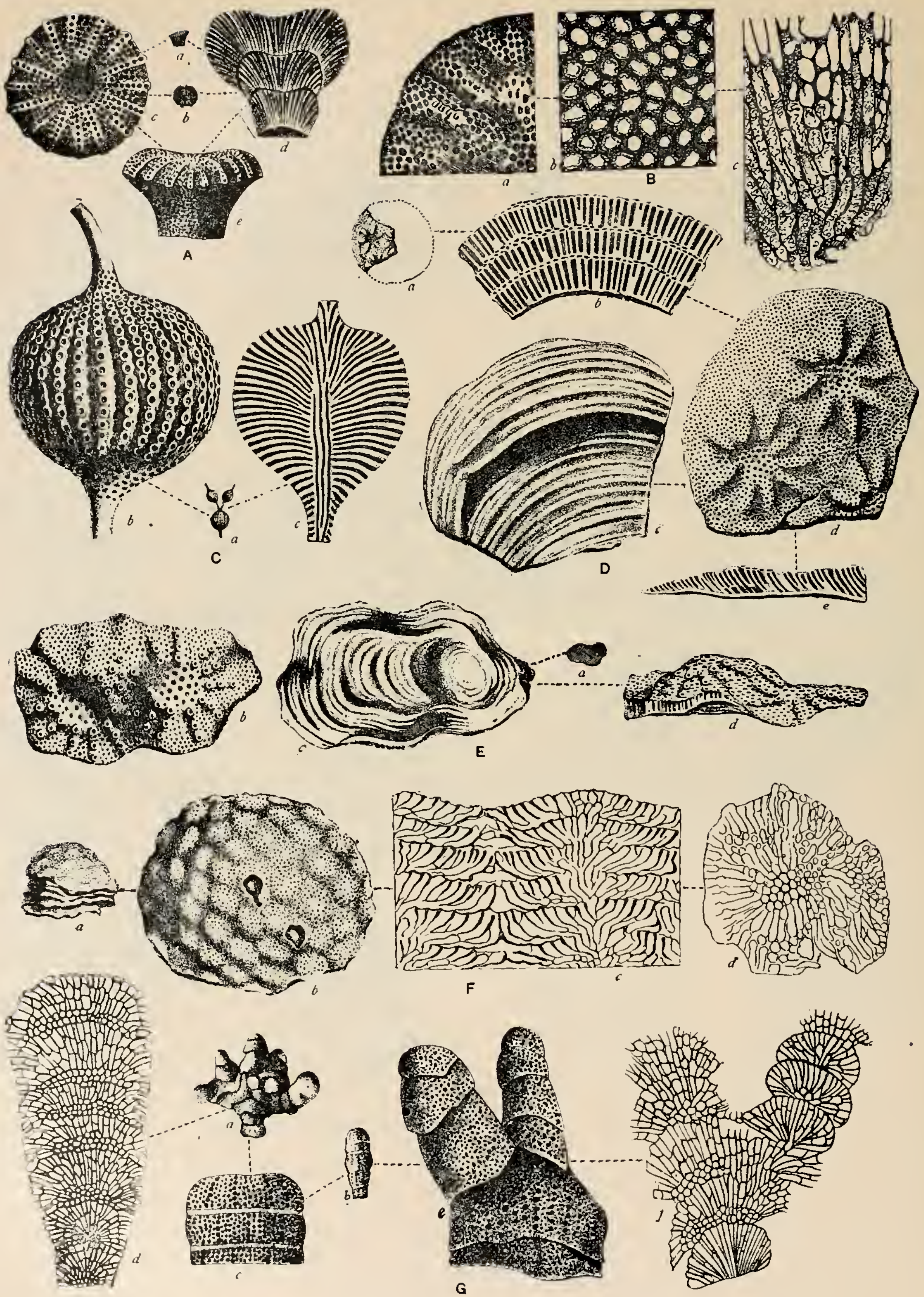

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Fig. 269.—Zoarial forms of *Lichenopora*.

FIG. 269.—Zoarial forms of *Lichenopora*.

A. *a–e*. *Discocavea* D'Orbigny, 1853. Genotype. *Discocavea irregularis* D'Orbigny, 1853. Various views of *Discocavea elegans* Simonowitch, 1871. (After Simonowitch.)

B. *a–c*. *Lichenopora* Defrance, 1823. Genotype *Lichenopora turbinata* Defrance, 1823. *Lichenopora stellata* Goldfuss, 1827. (After Gregory, 1909.) *a*. Portion of frontal; *b*. tangential thin section, × 20; *c*. vertical thin section, × 13½.

C. *a–c*. *Pyricavea* D'Orbigny, 1853. Views of the genotype *Pyricavea franqana* D'Orbigny, 1853. (After D'Orbigny.)

D, *a–c*. *Bimulticavea* D'Orbigny, 1853. Views of the genotype *Bimulticavea variabilis* D'Orbigny, 1853. (After D'Orbigny.)

E, *a–d*. *Semimulticavea* D'Orbigny, 1853. *Semimulticavea landrioti* D'Orbigny, 1853. (After D'Orbigny.)

F, *a–d*. *Radiopora* D'Orbigny, 1849. Zoarium, natural size and enlarged, of the genotype *Radiopora mendonensis* D'Orbigny, 1853. (After D'Orbigny.) *c*, *d*. longitudinal and transverse sections of *Radiopora neocomiensis* D'Orbigny, 1850. (After Gregory, 1909.)

G, *a–f*. *Tholopora* Gregory. 1909. (*Domopora* D'Orbigny. 1849.) G. *b*, *c*, *d*. Zoarium natural size, the extremity enlarged and a longitudinal thin section of the genotype *Domopora clavata* Goldfuss. 1827. G, *a*. *e*, *f*. Similar views of *Domopora virgulosa* Gregory, 1909. (After Simonowitch, 1871.)

### LICHENOPORA VERRUCOSA Philippi, 1843.

Plate 131, figs. 10–13, and plate 130, figs. 12, 13.

1843. *Ceriopora verrucosa* PHILIPPI, Beiträge zur Kenntniss der Tertiarversteinerungen des nordwestlichen Deutschlands, p. 67, pl. 1, fig. 12.

1864. *Heteroporella verrucosa* REUSS, Zur Fauna des deutschen oberoligocans, Sitzungsberichte der k. Academie der Wissenschaften, Wien, vol. 50, pt. 2, p. 68, pl. 7, figs. 1, 2.

1865. *Heteroporella verrucosa* REUSS, Die bryozoen des deutschen Septarienthones, Denkschriften der k. Akademie der Wissenschaften, Wien, vol. 25, p. 201 (sec. 85).

1869. *Heteroporella verrucosa* REUSS, Zur Fossilen der Oligocänschichten von Gaas, Sitzungsberichte der k. Akademie der Wissenschaften, vol. 59, p. 34.

1884. *Heteroporella verrucosa* SCHREIBER, Beiträge zur Fauna des mitteloligocänen Grunsandes aus dem Untergrunde Magdeburgs, vol. 2, p. 11, pl. 2, fig. 16.

*Description.*—The zoarium is simple or composite. When it is simple it is discoidal, very convex; the lower face is convex, pedunculate and the basal lamella is striated concentrically. The central area is large and is occupied by the ovicell. The fascicles are salient bi- or tri-serial, not continued as far as the zoarial border. The shorter ones are the more exterior. The tubes are polygonal and smaller than the cancelli. They have no visor. The cancelli are larger in the central area and smaller between the fascicles. The spinules are quite long, scattered, and very fragile. The ovicell is placed under the central area.

*Measurements.*—

| | |
|---|---|
| Width of the fascicles | 0.20 mm. |
| Diameter of the central cancelli | 0.16 mm. |
| Zoarial diameter | 6.00 mm. |
| Diameter of the interfascicular cancelli | 0.12 mm. |
| Diameter of the tube | 0.10–0.12 mm. |

*Affinities.*—The zoaria observed are simple and discoidal; sometimes they are superposed (as in *Domopora*).

This species much resembles *Lichenopora defranciana* Michelin, 1848, of the Paris Lutetian. It differs from it in its zoarium, which is not supported by a large peduncle and not turbinate, and in its convex and hollow lower face.

The comparison with German Oligocene fossils is always a little doubtful, these fossils never having been distributed to the principal museums of the world.

*Occurrence.*—Middle Jacksonian: Wilmington, North Carolina (rare); near Lenuds Ferry, South Carolina (rare).

*Geologic distribution.*—Middle and Upper Oligocene of Germany (Reuss); Stampian of Gaas in France (Reuss).

*Plesiotypes.*—Cat. Nos. 65363, 65454, U.S.N.M.

### LICHENOPORA GRIGNONENSIS Milne-Edwards, 1838.

Plate 129, figs. 1–11.

1823. *Lichenopora crispa* DEFRANCE, Dictionnaire des Sciences naturalles, vol. 26, p. 257.

1838. *Tubulipora grignonensis* MILNE-EDWARDS, Memoire sur les Tubulipores, Annales des Sciences naturalles, Paris, vol. 9, p. 13, pl. 13, fig. 2.

1845. *Tubulipora grignonensis* MICHELIN, Iconographie Zoophytologique, Paris, p. 169, pl. 46, fig. 7.

1852. *Unicavea grignonensis* D'Orbigny, Paléontologie française, Terrains crétacé, Bryozoaires, p. 971.
1852. *Discocavea parnensis* D'Orbingy, Paléontologie française, Bryozoaires, p. 958.
1852. *Radiotubigera grignonensis* D'Orbigny, Paléontologie française, p. 756.
1852. *Discocavea crispa* D'Orbigny, Paléontologie française, p. 958.
1886. *Discoporella grignonensis* Pergens and Meunier, Les Bryozoaires du Système Montien, Louvain, p. 14.
1909. *Lichenopora grignonensis* Canu, Bryozoaires tertiares des environs de Paris, Annales de Paleontologie, vol. 5, p. 134, pl. 17, figs. 3–7.

*Description.*—The zoarium is simple, free, and discoidal or composite incrusting, formed of a lamella with adjacent subcolonies. The basal lamella is thick and striated concentrically. The central area is large and concave. The fascicles are salient, solely in the vicinity of the central area; they are uniserial, short, and never reach the zoarial margins. The tubes are small, recumbent, provided with a visor; they are arranged in quincunx in the vicinity of the zoarial margins. The cancelli are polygonal and small. The ovicell placed in the central area covers over the cancelli.

*Measurements.*—
Diameter of the cancelli.................... 0.06–0.10 mm.
Diameter of the tubes...................... 0.10 mm.
Maximum diameter of the simple zoaria..... 0.75 mm.

*Affinities.*—This species is evidently the *Lichenopora hispida* Fleming, 1828, universally distributed throughout all the seas of the globe. The variations noted in this species are so extraordinary that a revision of the known specimens appears necessary. The oeciostome figured by Hincks has not been rediscovered; the ovicelled specimens from the Mediterranean have never shown it. The arrangement in quincunx of the tubes on the zoarial margins does not therefore appear as a sufficient specific character if it is not supplemented by the character of the ovicell, the oeciostome, and the cancelli. In adopting the name *Lichenopora grignonensis* we are certain of having made a good identification, the comparison of the specimens having been made directly. Some subsequent studies will make the synonyms more specific.

The composite zoaria appear to incrust algae, forming a greater or less thickness with many lamellae superposed. Two specimens from Cocoa post office, Choctaw County, Alabama, are hollow and measure 6 by 2½ centimeters.

*Occurrence.*—Midwayan (Clayton limestone); Luverne, Crenshaw County, Alabama (common); 1 mile west of Fort Gaines, Georgia (rare).

Claibornian: Claiborne, Alabama (very rare).

Jacksonian: Three and one-half miles southeast of Shell Bluff post office, Georgia (common).

Lower Jacksonian (Moodys marl): Jackson, Mississippi (common).

Middle Jacksonian: Wilmington, North Carolina (very common); near Lenuds Ferry, South Carolina (very common); Eutaw Springs, South Carolina (common); 18 miles west of Wrightsville, Johnson County, Georgia, (rare); Rich Hill, 5¼ miles southeast of Knoxville, Crawford County, Georgia; 3¼ miles south of Perry, Georgia (rare).

Upper Jacksonian (Ocala limestone): Chipola River, east of Marianna, Jackson County, Florida (rare); 1½ miles above Bainbridge, Georgia (rare).

Jacksonian (Zeuglodon bed): Bluff on south side of Suck Creek, Clarke County, Mississippi (rare); Shubuta, Mississippi (rare); Pachuta, Clarke County, Mississippi (rare); Cocoa post office, Choctaw County, Alabama (rare).

*Geological distribution.*—Lutetian of the environs of Paris (Canu).

*Plesiotypes.*—Cat. Nos. 65259, 65260, U.S.N.M.

### LICHENOPORA GRIGNONENSIS, var. MULTILAMELLOSA, new variety.

Plate 133, figs. 14–17.

We have discovered some multilamellar zoaria which offer the aspect of true *Ceriopora* because they are altered by fossilization. The fascicles are hardly visible, and exact determination is impossible. Nevertheless the cancelli are much smaller than on the similar masses of *Lichenopora boletiformis* Reuss, 1869. The superposed lamellae are not always intimately joined; in dissecting away a fragment of the upper lamella of a specimen from Rich Hill, Georgia, we have verified on the well-preserved lower lamella the presence of the fascicles and the visors characteristic of *Lichenopora grignonensis*. This latter species never having been found in all the localities mentioned, we believe it necessary to establish a variety, but this is very probably only a simple variation analogous to that already mentioned in other composite *Lichenopora*. The ovicell observed was concave at the center and convex between the fascicles.

*Occurrence.*—Middle Jacksonian: One-half mile south of Georgia Kaolin Company's mine, Twiggs County Georgia (rare); Baldock, Barnwell County, South Carolina (rare); Rich Hill, 5¼ miles southeast of Knoxville, Crawford County, Georgia (common); 17 miles northeast of Hawkinsville, Georgia.

*Cotypes.*—Cat. No. 65365, U.S.N.M.

### LICHENOPORA PROLIFERA Reuss, 1847.

Plate 162, figs. 4–7.

1847. *Defrancia prolifera* Reuss, Die fossilen Polyparien des Wiener Tertiärbeckens, Haidinger's naturwissenschaftliche Abhandlungen, vol. 2, p. 37, pl. 6, fig. 1.

1851. *Defrancia prolifera* Reuss, Ein Beitrag sur Paleontologie der Tertiarschichten oberschlesens, Zeitschrift der Deutschen Geologischen Gesellschaft, vol. 3, p. 175.

1862. *Defrancia prolifera* Stoliczka, Oligocane Bryozoen von Latdorf in Bernburg, Sitzungsberichte der k. Akademie der Wissenschaften, Wein, vol. 45, p. 82.

1877. *Defrancia prolifera* Manzoni, I Brozoi fossili del Miocene d'Austria ed Ungheria, III, Denkschriften der k. Akademie der Wissenschaften, Wien, vol. 38, p. 17, pl. 15, fig. 58.

1895. *Lichenopora prolifera* Neviani, Briozoi fossili delle Farnesina Monte presso Roma, Palontographia italica, vol. 1, p. 135 (39).

1896. *Lichenopora prolifera* Neviani, Briozoi postpliocenici di Spilinga (Calabria), Atti dell'Academie Gioenia di Scienze naturali in Catalina, ser. 4, vol. 9, p. 65.

1898. *Lichenopora prolifera* Neviani, Briozoi neozoici di alcune località d'Italia, Bollettino della Societá Romana par gli Studi Zoologici, pt. 4, vol. 7, p. 16; pt. 5, p. 15.

1900. *Lichenopora prolifera* Neviani, Briozoi neogenici delle Calabrie, Paleontographia italica, vol. 6, p. 247 (sep. 133).

*Description.*—The zoarium is simple, very convex, and discoidal or composite, and formed of superposed disks; the lower face is concave with a peduncle hardly salient and striated concentrically on the basal lamella. The central area is very large. The fascicles are salient, regular, from 18 to 22 in number, continued almost to the zoarial margin, monoserial. The tubes are rectangular, smaller than the cancelli and without visor. The cancelli are large and polygonal.

| | | |
|---|---|---|
| *Measurements.*— | Diameter of the cancelli | 0.12 mm. |
| | Diameter of the tubes | 0.10 mm. |
| | Diameter of the zoaria | 3.00 mm. |

*Affinities.*—There is in the Oligocene a species very close to *Heteroporella deformis* Reuss, 1847, but in which the central area is much smaller. This species was refigured in 1877 by Manzoni with very different characters from the figure by Reuss, 1864, not cited, moreover, in the synonymy. On the other hand, Stoliczka, 1861, having found the species of Reuss, 1847, in the Lower Oligocene of Latdorf, its discovery in the Vicksburgian is not unexpected. Our specimens are much like the figures of *Lichenopora prolifera* by Reuss and Manzoni, and our identification appears to be good.

Neviani cited this species in the Pliocene and in the Quarternary. Perhaps he confused it with *Lichenopora radiata* Savigny-Audouin, 1826, although distinction between the two species ought to be easy to determine.

*Occurrence.*—Vicksburgian (Marianna limestone): Salt Mountain, 5 miles south of Jackson, Alabama (rare).

*Geological distribution.*—Latdorfian of Germany (Stoliczka); Helvetian of Italy (Neviani); Tortonian of Austria-Hungary (Reuss); Astian of Italy (Neviani).

*Plesiotypes.*—Cat. No. 65473, U.S.N.M.

### LICHENOPORA GOLDFUSSI Reuss, 1864.

Plate 162, figs. 8–20.

1847. *Defrancia stellata* Reuss, Die fossilen polyparien des Wiener Tertiärbeckens, Haidingers' naturwissenschaftliche Abhandlungen, vol. 2, p. 37, pl. 6, fig. 2. (Not Goldfuss, 1827.)

1864. *Radiopora goldfussi* Reuss, Zur fauna des deutschen Oberoligocäns, Sitzungsberichte der k. Akademie der Wissenschaften, Wien, vol. 5, p. 676 (sep. 65.)

1865. *Radiopora goldfussi* Reuss, Ueber die Foraminiferen und Bryozoen des deutschen Septarienthones, Denkschriften der k. Akademie der Wissenschaften, Wien, vol. 25, p. 84, pl. 10, figs. 11, 12.

1877. *Defrancia stellata* Manzoni, I Briozoi fossili del Miocene d'Austria ed Ungheria, Denkschriften der k. Akademie der Wissenschaften, Wien, vol. 37, p. 16, pl. 16, fig. 63.

*Description.*—The zoarium is simple, discoidal, very convex; the lower face is very concave and striated concentrically. The fascicles are salient, regular, triserial, complete almost to the zoarial margins; the central area is small. The tubes are a little smaller than the central cancelli. They are polygonal and deprived of a visor. The cancelli are large, polygonal, and without spinule.

| | | |
|---|---|---|
| *Measurements.*— | Diameter of the tubes | 0.10 mm. |
| | Diameter of the cancelli | 0.10–0.14 mm. |
| | Diameter of the large zoaria | 8.00 mm. |
| | Width of the fascicles | 0.30–0.40 mm. |

*Affinities.*—In its multiserial fascicles this species much resembles *Lichenopora verrucosa* Philippi, 1843. It differs from it in the greater width of its fascicles, which are continued almost to the zoarial margins. The orifice of the cancelli is less excavated.

In 1877 Manzoni did not appear to admit the identity of the Oligocene species with the Miocene; we do not see, however, any essential difference. Our specimens from Monroeville, Alabama, are very well represented by the figures given for the Miocene form, although generally the central area is much smaller.

We have not discovered the ovicell, nor the spinules. The species is perhaps not a *Lichenopora*, and it will be necessary to await the collection of a large number of specimens before placing it definitely.

*Occurrence.*—Vicksburgian (Marianna limestone): One mile north of Monroeville, Alabama (very abundant); Salt Mountain, 5 miles south of Jackson, Alabama (common); near Claiborne, Monroe County, Alabama (rare).

*Geological distribution.*—Rupelian of Germany (Reuss); Chattian of Germany (Reuss); Tortonian of Austria-Hungary (Reuss).

*Plesiotypes.*—Cat. No. 65474, U.S.N.M.

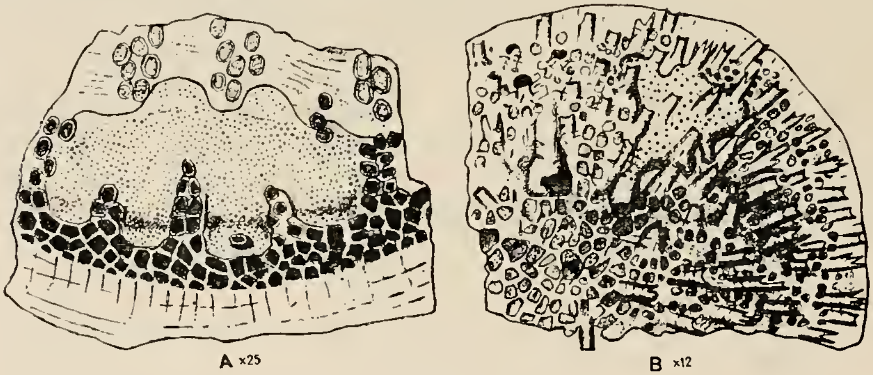

Fig. 270.—*Orosopora*, new genus.

A. Ovicelled specimen, × 25, of *Desmeplagioecia* (*Lichenopora*) *linetata* MacGillivray. (After Waters, 1888.) (Introduced by error.)

B. Portion of ovicelled zoarium, × 12, of *Orosopora* (*Lichenopora*) *ciliata* Busk, 1875. (After Waters, 1887.)

### OROSOPORA, new genus.

Greek: *oros*, signifying border.

The ovicell is placed near the zoarial margin and not at the center of the zoarium.

*Genotype.*—*Orosopora* (*Lichenopora*) *ciliata* Busk, 1875.

*Range.*—Recent.

### Genus TROCHILIOPORA Gregory, 1909.

1909. *Trochiliopora* Gregory, Catalogue Fossil Bryozoa in Department of Geology, British Museum, Cretaceous Bryozoa, vol. 1, p. 265.

Lichenoporidae with a single top shape or capitate zoarium, composed of a constricted stem and expanded head. Apertures in vertical series on the margin of the head. (After Gregory.) The lower face bears cancelli.

*Genotype.*—*Trochiliopora humei* Gregory, 1909. Santonian.

### Genus CONOCAVA Calvet, 1911.

1911. *Conocava* Calvet, Diagnoses de quelques espèces nouvelles de Bryozaires Cyclostomes provenant des Campagnes scientifiques accomplies par S.A.S. le Prince de Mouaco a bord de la *Princesse Alice*, Bulletin Institut oceanographia Monaco, No. 215, p. 8.

Zoarium conical, fixed to the substratum by its enlarged summit and increasing in size at the base. Lateral surface occupied in part by salient series of tubular zooecia, arranged side by side, and according to as many generatrices of the colonial cone as there are series, these being separated from each other by depressions where the intermediate pores are found. (Calvet.)

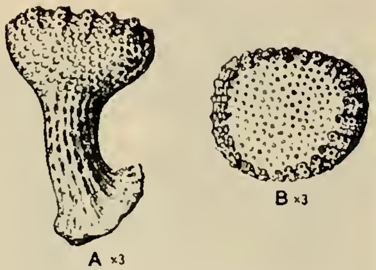

Fig. 271.—Genus *Trochiliopora* Gregory, 1909.

Side and top views, × 3, of the type of the genus *Trochiliopora humei* Gregory, 1909, from the Chalk of England.

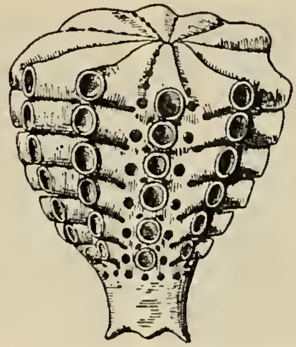

Fig. 272.—Genus *Conocava* Calvet, 1911.

Zoarium of *Conocava richardi* Calvet, 1911, × 22.

*Genotype.—Conocava richardi* Calvet, 1911.

*Range.*—Recent.

## LEIOSOECIIDAE, new family.

The ovicell is a large, orbicular, smooth, salient swelling, elevated above a shallow excavation and obstructing a certain number of tubes.

This family offers the greatest analogy with that of the Plagioeciidae with which it will be necessary to join it if we find intermediate forms. It has only appeared to differ from it in a greater constancy of the orbicular form of the ovicell and in the presence of mesopores. The ovicell of the Ceidae is also very close, as is that of *Entalophora ramossissima* D'Orbigny, 1851.

### LEIOSOECIA, new genus.

Greek: *leois*, smooth, in allusion to the aspect of the ovicell.

The tubes are cylindrical. The mesopores are parietal and regular.

*Genotype.—Leiosoecia* (*Multicrescis*) *parvicella* Gabb and Horn, 1860, Maastrichten.

## PARLEIOSOECIA, new genus.

The prefix "par" indicates the presence of club-shaped tubes.

The tubes are club-shaped, bent at right angles at their extremity. The mesopores are numerous with vesicular walls.

*Genotype.—Parleiosoecia jacksonica*, new species. Jacksonian.

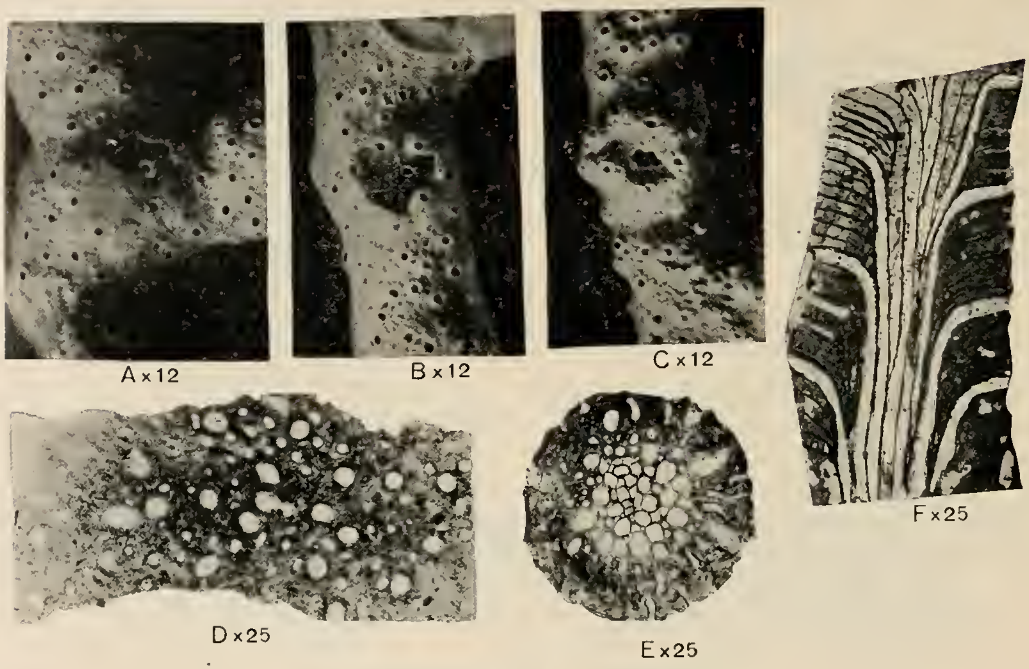

Fig. 273.—*Leiosoecia*, new genus.

A–F. *Leiosoecia* (*Multicrescis*) *parvicella* Gabb and Horn, 1860. A–C. Three views of ovicelled specimens, × 12, showing that the ovicell obstructs a number of the zooecia. D. Tangential thin section, × 25. E. Transverse thin section, × 25. F. Vertical thin section, × 25, showing the cylindrical tubes and the mesopores.

Upper Cretaceous (Vincentown marl) at Vincentown, New Jersey.

### PARLEIOSOECIA JACKSONICA, new species.

Plate 148, figs. 1–13.

*Description.*—The zoarium is free, solid or hollow, irregularly cylindrical and branched; sometimes clinging to algae or to bryozoa, sometimes attached to the substratum by an expanded base. The tubes are club-shaped in the great part of their length, bent and cylindrical at their extremity (sections); the peristome is orbicular, thin, somewhat salient. The mesopores are numerous, polygonal with vesicular walls (section). The ovicell is orbicular, globular, very salient. absolutely smooth.

| | | |
|---|---|---|
| *Measurements.*— | Diameter of the peristome | 0.12 mm. |
| | Interior diameter of the tubes (section) | 0.06–0.08 mm. |
| | Maximum diameter of the branches | 1.8 mm. |
| | Diameter of the mesopores | 0.64 mm. |
| | Diameter of the ovicell | 1.35 mm. |

*Affinities.*—Exteriorly this species, much resembles *Leiosoecia parvicella* Gabb and Horn, 1860, from the Cretaceous of New Jersey; it differs from it in its club-shaped tubes, its hollow zoarium, and in its larger and more globular ovicell.

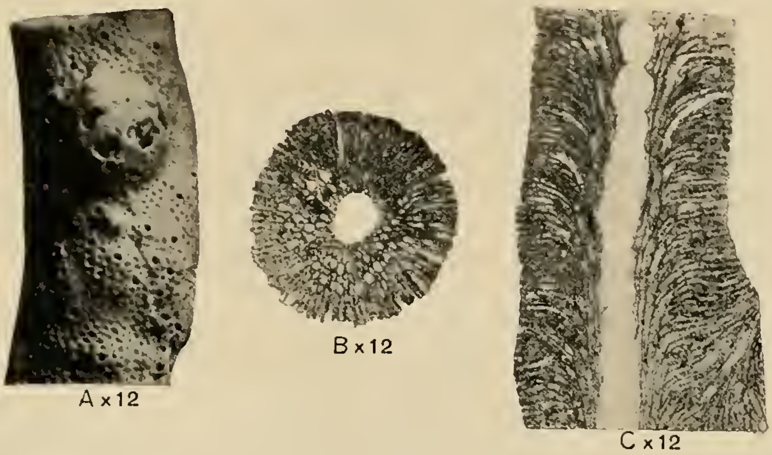

Fig. 274.—*Parleiosoecia*, new genus.

A–C. *Parleiosoecia jacksonia*, new species. A. Ovicelled branch, × 12, showing the smooth ovicell. B. Transverse section, × 12. C. Vertical section, × 12.

Middle Jacksonian of South Carolina.

It appears rather close to *Heteropora subreticulata* Reuss, 1869, from the Priabonian of Vicentin, but it differs from it in the exterior form of the mesopores. The interior of the branches presents (fig. 13) a successive series of rather regular constrictions, the utility of which is not yet known. They do not correspond to the form of an internal substratum, for the branches are naturally hollow and closed at their extremities. These internal cavities are often traversed by very convex diaphragms (fig. 12).

At the ramifications the walls of the mesopores cease to be vesicular, transforming themselves thus into firmatopores or canals of reinforcement.

*Occurrence.*—Middle Jacksonian. Wilmington, North Carolina (rare); near Lenuds Ferry, South Carolina (rare); Eutaw Springs, South Carolina (very common); 18 miles west of Wrightsville, Johnston County, Georgia (very rare); Rich Hill, 5¼ miles southeast of Knoxville, Crawford County, Georgia (rare); 17 miles northeast of Hawkinsville, Georgia (very common).

*Cotypes.*—Cat. Nos. 65446–65451, U.S.N.M.

## Family TRETOCYCLOECIIDAE Canu, 1919.

1919. *Tetrocycloeciidae* (in error for *Tretocycloeciidae*) Canu, Etudes sur les Ovicelles des Bryozoaires Cyclostomes (2), Bulletin Société Géologique de France, ser. 4, vol. 17, p. 346.

The ovicell is orbicular, flat, not salient, smooth, regular, and limited, traversed by tubes and sometimes by mesopores adjacent to the latter.

This family has a resemblance to the Diaperoeciidae, but differs from it in the flat orbicular and not globular form of the ovicell, and in the presence of the mesopores.

### Genus TRETOCYCLOECIA Canu, 1919.

1919. *Tetrocycloecia* (in error for *Tretocycloecia*) Canu, Etudes sur les Ovicelles des Bryozoaires Cyclostomes (2), Bulletin Société Géologique de France, ser. 4, vol. 17, p. 346.

The tubes are cylindrical. The mesopores are irregularly directed; their walls are vesicular. The tubes which perforate the ovicell are accompanied by the adjacent mesopores.

*Genotype.*—*Tretocycloecia* (*Heteropora*) *dichotoma* Reuss, 1847 (not Hagenow, 1851).

*Range.*—Midwayan-Tortonian.

#### TRETOCYCLOECIA (?) ATTENUATA Ulrich, 1882.

Plate 109, figs. 1–9.

1882. *Heteropora attenuata* Ulrich, American Paleozoic Bryozoa, Journal Cincinnati Society Natural History, vol. 5, p. 144, pl. 6, fig. 12.

1909. *Sparsicavea attenuata* Gregory, Catalogue Fossil Bryozoa in Department Geology British Museum, Cretaceous, vol. 2, p. 302.

*Description.*—The zoarium is solid, cylindrical, branched, with branches rounded at the summit. The tubes are cylindrical, curved at their extremity (in section). The peristome is smooth, orbicular, not salient, imperfectly visible. The mesopores are rare, rounded, smaller than the tubes, with very thick walls and in section very short and with vesicular walls.

*Measurements.*—

| | |
|---|---|
| Diameter of the aperture | 0.08–0.10 mm. |
| Diameter of the peristomes | 0.10–0.16 mm. |
| Diameter of the branches | 2.00 mm. |
| Diameter of the mesopores | 0.06–0.08 mm. |
| Diameter of the ovicell | 1.00 mm. |

*Variations.*—The number of the mesopores surrounding an aperture is rather variable. More often there is only one mesopore between the peristomes; sometimes the mesopores are in groups of six or seven. The branches are sometimes dichotomous and sometimes arborescent. The distance between two mesopores is almost always greater than their diameter.

The only ovicell discovered was broken; we are therefore not exactly certain of our generic determination.

*Affinities.*—This species exteriorly resembles worn specimens of *Ascosoecia prominens;* it differs from it in the great thickness of the walls of the mesopores.

It differs from *Tretocycloecia reticulata* in its branched, nonreticulate and smaller zoarium, in its much less numerous mesopores, and in its apertures, which are arranged in somewhat regular quincunx.

*Occurrence.*—Midwayan (Clayton limestone): Mabelvale, near Little Rock, Arkansas (rare).

*Cotypes.*—Cat. No. 65256, U.S.N.M.

### TRETOCYCLOECIA GRANDIS, new species.

Plate 150, figs. 7–10.

*Description.*—The zoarium is flat, cylindrical, branched. The tubes are cylindrical or polygonal, bent obliquely at their extremity. The peristome is thin, orbicular, salient. The apertura is large. The mesopores are large, polygonal, irregularly grouped, and always closed by a calcareous pellicle rather resistant and finely perforated. The ovicell is orbicular.

| | | |
|---|---|---|
| *Measurements.*— | Diameter of the apertura | 0.10 mm. |
| | Diameter of the peristome | 0.15 mm. |
| | Diameter of the branches | 3.20 mm. |
| | Diameter of the mesopores | 0.10 mm. |
| | Diameter of the ovicell | 1.25 mm. |

*Affinities.*—This species offers much the aspect of the *Pustulopora* (*Clausa*) *retifera* Stoliczka, 1861, of the Latdorfian, the type of which we have not been able to compare. It differs in its mesopores, the diameter of which never surpasses that of the tubes, and in larger apertures (0.10 and not 0.06 mm.).

The figured specimen is the only one found. The study of the species is therefore incomplete.

*Occurrence.*—Lower Jacksonian (Moodys marl): Jackson, Mississippi (very rare).

*Holotype.*—Cat. No. 65372, U.S.N.M.

### TRETOCYCLOECIA RETICULATA, new species.

Plate 149, figs. 1–14.

*Description.*—The zoarium is free, solid, cylindrical, large, reticulate. The tubes are very long, cylindrical, bent at a right angle at their extremity; the apertures are orbicular, grouped in irregular zones (in section). The mesopores are exteriorly small, polygonal, with thin walls, grouped in irregular, transversal zones, and of a large diameter in section; the walls are vesicular. Diaphragms in the tubes are rare. The ovicell is orbicular, hardly salient.

| | | |
|---|---|---|
| *Measurements.*— | Diameter of the apertura | 0.12 mm. |
| | Diameter of the mesopores | 0.05 mm. |
| | Diameter of the branches | 5.00 mm. |

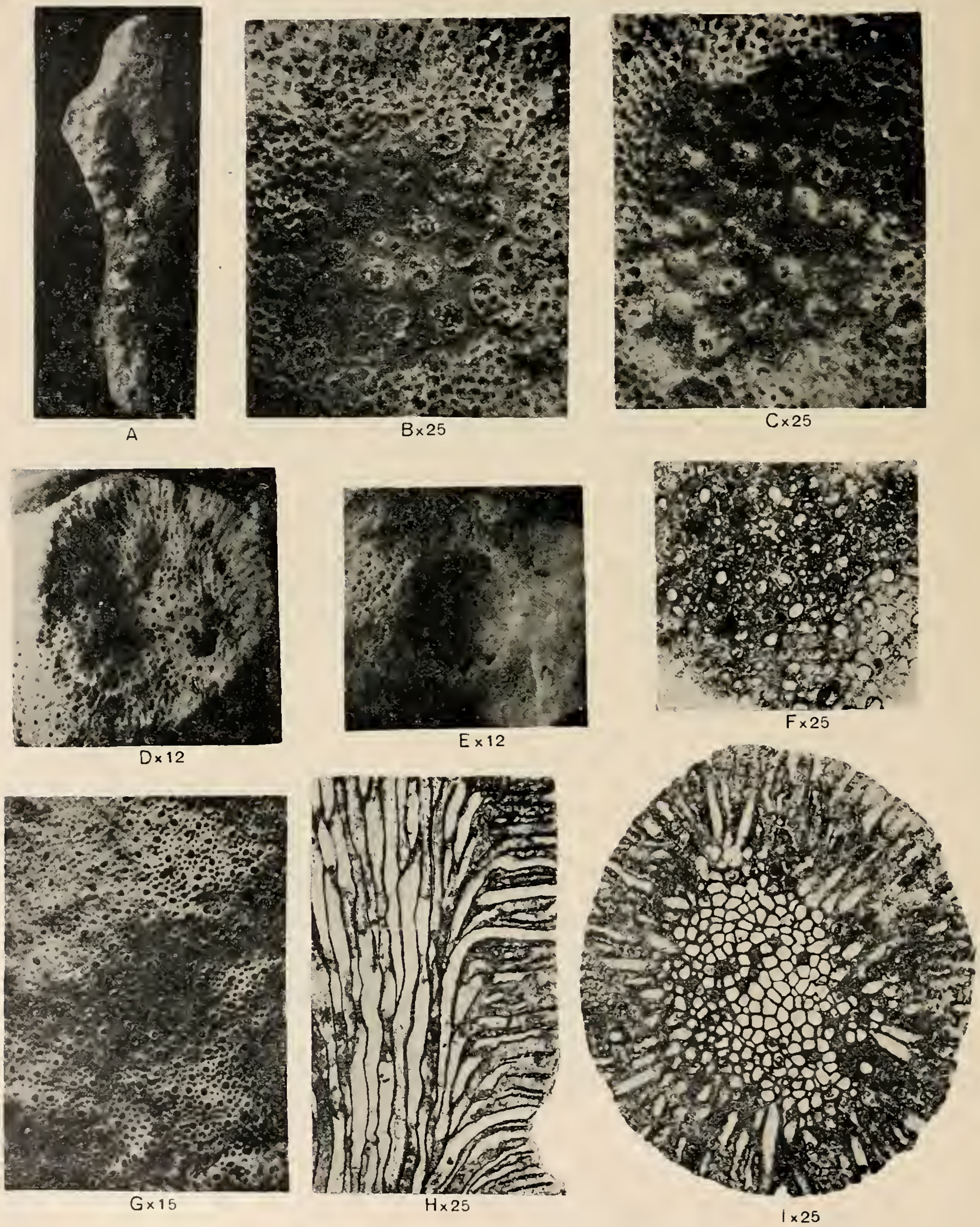
A
B×25
C×25
D×12
E×12
F×25
G×15
H×25
I×25

FIG. 275.—Genus *Tretocycloecia* Canu, 1919.

Fig. 275.—Genus *Tretocycloecia* Canu, 1919.

A–I. *Tretocycloecia* (*Heteropora*) *dichotoma* Reuss, 1847. A. Zoarium, natural size. B. Surface, × 25, showing ovicell pierced by the tubes with accompanying mesopores. C. Interior of the ovicell, × 25. D. Surface of specimen, × 12, showing ovicell covered by a new layer of tubes and made visible by fracture. E. Another example, × 12, showing the interior of the ovicell. F. Tangential thin section, × 25. G. Surface of zoarium, × 15. H. Vertical thin section, × 25. I. Transverse thin section, × 25.

Helvetian of Doue la Fontaine (Maine et Loire) and Mus (Gard), France.

*Variations.*—The zoaria are not always reticulate; it is frequent to find branches free, smooth, or spinous. The relative arrangement of the apertura and mesopores is that of *Sparsicavea;* the zones are almost always transversal, but very irregular (fig. 3). The mesopores are sometimes closed by a calcareous lamella.

An excellent longitudinal section permitted us to study the branching of the zoaria (fig. 11). At the center of the zoarium and quite distant from the bifurcation, two tubes diverge, an axial tube to the left and an axial tube to the right; their successive ramifications diverge necessarily in forming the two zoarial branches.

The mesopores have a diameter almost equal to that of the tubes; this character is not visible in the tangential sections (fig. 13). The zones of mesopores appear to be formed of branched mesopores (figs. 11, 12).

*Affinities.*—In its reticulate zoarium and in the aspect of its surface, this species is identical with *Ascosoecia ulrichi;* it differs from it in its somewhat larger apertura (0.12 and not 0.10 mm.).

*Occurrence.*—Middle Jacksonian: Near Lenuds Ferry, South Carolina (rare); Eutaw Springs, South Carolina (very common).

*Cotypes.*—Cat. No. 65374, U.S.N.M.

### Genus PARTRETOCYCLOECIA Canu, 1919.

1919. *Partetroeycloecia* (in error for *Partretocycloecia*) CANU, Etudes sur les Ovicelles des Bryozoaries Cyclostomes (2), Bulletin Société Géologique de France, ser. 4, vol. 17, p. 346.

The tubes are club-shaped.

*Genotype.*—*Partretocycloecia* (*Cavaria*) *dumosa* Ulrich.

*Range.*—Midwayan-Vicksburgian.

All the known species of this genus have hollow zoaria (*Cavaria* form of growth). The tubes are short and their club-shaped form does not appear very clearly in transversal sections. It would be preferable to chose a genotype with a solid zoarium.

Another consequence of the contraction is to transform certain mesopores into aborted tubes; that is to say, into dactylethrae.

#### PARTRETOCYCLOECIA DUMOSA Ulrich, 1901.

Plate 103, figs. 1–14.

1901. *Cavaria dumosa* ULRICH, Maryland Geological Survey, Eocene, p. 208, pl. 59, figs. 4–8.

*Description.*—The zoarium is free, hollow, branched, dichotomous, arborescent. The tubes are short, club-shaped, cylindrical, with their extremity bent (in section). The peristomes are orbicular, hardly salient, thin, irregularly distributed in quincunx. The mesopores are smaller, polygonal, but rounded and (in section) with thick walls. The ovicell is large, smooth, perforated by the tubes; each tube is accompanied by a single mesopore.

| | | |
|---|---|---|
| *Measurements.*— | Diameter of the orifices | 0.08 mm. |
| | Diameter of the mesopores | 0.07 mm. |
| | Diameter of the branches | 2.20 mm. |
| | Diameter of the ovicell | 1.10 mm. |

*Variations.*—This species has been very well described by Ulrich. Even the ovicell has been well studied and figured. We have nothing new to add.

The zoarial cavities are irregular and as they are closed we have supposed that they were hydrostatic.

The adventitious tubes are indeed mesopores and not dactylethrae, for they arise in front of normal tubes and not on their dorsal.

*Occurence.*—Lowest Eocene (Bryozoan bed at base of Aquia formation): Upper Marlboro, Maryland (very common).

*Plesiotypes*—Cat. No. 65239, U.S.N.M.

### PARTRETOCYCLOECIA REPTANS, new species.

Plate 150, figs. 11–14.

*Description.*—The zoarium *creeps* over bryozoa. It probably gives rise to free and hollow fronds. The tubes are club-shaped. The peristomes are orbicular, very thin, little salient, irregularly arranged. The mesopores are numerous, polygonal, closed by a calcareous lamella. The ovicell is large, orbicular, pierced by the tubes, but never by the mesopores.

| | | |
|---|---|---|
| *Measurements.*— | Diameter of the peristomes | 0.10–0.12 mm. |
| | Diameter of the orifices | 0.08–0.10 mm. |
| | Diameter of the mesopores | 0.06 mm. |
| | Diameter of the ovicell | 2.00 mm. |

*Affinities.*—D'Orbigny classified this zoarial form in *Reptomulticlausa.* The absolute identity of its ovicell with the other species of *Partretocycloecia* requires its classification here. The figured specimen is the only one found.

*Occurrence.*—Middle Jacksonian: Near Lenuds Ferry, South Carolina (very rare).

*Holotype.*—Cat. No. 65373, U.S.N.M.

### PARTRETOCYCLOECIA POROSA, new species.

Plate 151, figs. 1–6.

*Description*—The zoarium is massive, orbicular, formed of many superposed layers. The tubes are very short, club-shaped, bent at their extremity (in section); the peristomes are thin, salient, numerous, elliptical or oval, arranged in quincunx. The mesopores are numerous, polygonal, smaller than the peristomes, with non-vesicular walls. The ovicell is very large, orbicular, perforated by the tubes, but not perforated by the mesopores.

| | | |
|---|---|---|
| *Measurements.*— | Diameter of the peristomes | 0.16 mm. |
| | Diameter of the mesopores | 0.04–0.08 mm. |
| | Diameter of the zoaria | 10.00 mm. |
| | Diameter of the ovicell | 0.35–0.38 mm. |

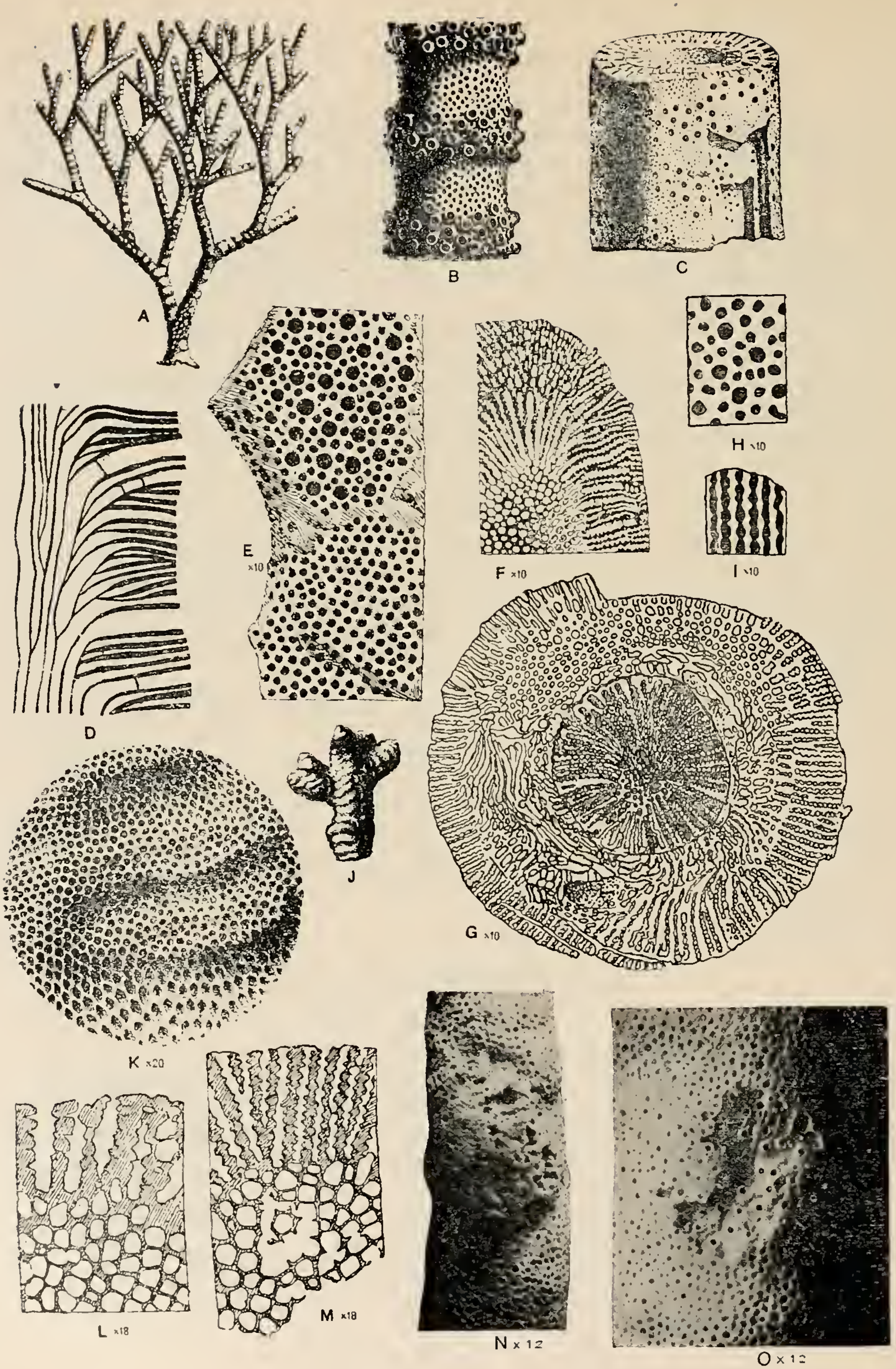
A
B
C
D
E ×10
F ×10
H ×10
I ×10
G ×10
J
K ×20
L ×18
M ×18
N × 12
O × 12

Fig. 276.—Genus *Ascosoecia* Canu, 1919.

Fig. 276.—Genus *Ascosoecia* Canu, 1919.

Forma *Zonopora* D'Orbigny, 1854 (=*Zonatula* Gregory, 1909).

A–I. *Ascosoecia* (*Zonopora*) *arborea* Koch and Dunker, 1837. A. Zoarium restored, natural size, from the Neocomian of France. B. Surface of a well preserved zoarium with salient peristomes. C. Surface of a worn zoarium with nonsalient peristomes. (A–C, after D'Orbigny, 1854.) D. Longitudinal section. (After Pergens, 1889.) The walls are vesicular. E. Surface of a zoarium of the variety *subnodosa*, × 10. F. Transverse section of the same variety, × 10. G. Transverse section, × 10, showing, like the preceding, that the walls of the tubes are vesicular (=moniliform of Gregory). H. A transverse section, × 10, showing the apertures and single circle of mesopores. I. Part of a vertical section, × 10, from the same specimen showing the moniliform walls of the zooecia. (D–I. After Gregory, 1909.)

*Ascosoecia* (*Zonatula*) *pseudotorquata* Hagenow, 1851. J. Zoarium, natural size, from the Cretaceous at Maastricht. K. Portion of the surface, × 20. (After Pergens, 1893.)

L. Part of a vertical section, × 18, near the edge of a zoarium of var. *irregularis* showing zooecia cut longitudinally and transversally, and moniliform distal walls of the outer zooecia.

M. Part of the vertical section, × 18, of a long branch, 5 mm. in diameter, of var. *irregularis*. (L, M, after Gregory, 1909.)

*Ascosoecia* (*Zonopora*) *ligeriensis* D'Orbigny, 1853. N. Ovicell found on a specimen from the Maastrichtian at Royan, France, × 12. O. Interior of ovicell on a specimen from the same locality, × 20.

*Variations.*—The great number of peristomes and mesopores which ornament the surface of this bryozoan give it a very characteristic porous aspect. Moreover, the oval peristomes are unique in the genus. The longitudinal sections which we have made are not very clear. They simply indicate the superposition of the multiple layers composing the zoarium. The walls of the tubes and mesopores do not appear vesicular.

In its exterior aspect this species much resembles *Lichenopora*, especially if we observe the oval form of the peristomes. But the nature of its ovicell does not permit that it be classed with these well-known bryozoa.

*Occurrence.*—Middle Jacksonian: Eutaw Springs, South Carolina (common).

*Cotypes.*—Cat. No. 65368, U.S.N.M.

### PARTRETOCYCLOECIA EXILIS, new species.

Plate 160, figs. 5–16.

*Description.*—The zoarium is hollow, cylindrical, bifurcated, with large central cavities and *thin* walls. The tubes are club-shaped in their lower part and cylindrical where the mesopores are developed (in section). The peristomes are thin, orbicular, hardly salient, arranged vaguely in very irregular, transverse rows. The ovicell is orbicular, somewhat salient, pierced by tubes each of which is accompanied by a mesopore.

| | | |
|---|---|---|
| *Measurements.*— | Diameter of the peristome | 0.10–0.12 mm. |
| | Diameter of the mesopores | 0.08 mm. |
| | Diameter of the ovicell | 1.65 mm. |
| | Diameter of the branches | 3.00 mm. |

*Variations.*—The peristomes are salient (figs. 9, 10) or not (figs. 11, 12). The mesopores are small (fig. 9), medium (fig. 10), or large and polygonal (fig. 12), according to the degree of weathering.

In the longitudinal section it is impossible to confirm the nature of the tubes, whether they are cylindrical or club-shaped.

*Affinities.*—In its exterior aspect this species much resembles *Partretocycloecia dumosa* Ulrich, 1901. It is distinguished from it only by its micrometric dimensions, in its smaller ovicell, and in its larger internal cavities. The size of the latter is in fact very characteristic.

*Occurrence.*—Vicksburgian (Marianna limestone): One mile north of Monroeville, Alabama (very common).

*Cotypes.*—Cat. No. 65413, U.S.N.M.

## Family ASCOSOECIIDAE Canu, 1919.

1919. *Ascosoeciidae* Canu, Etudes sur les Ovicelles des Bryozoaires Cyclostomes (2), Bulletin Société Géologique de France, ser. 4, vol. 17, p. 346.

The ovicell is a large, elliptical, elongate swelling quite salient and perforated by the tubes; often a median oeciopore is present.

This family offers the greatest resemblances to the Diaperoeciidae. It differs from it chiefly in the more constant form of the ovicells and in the presence of mesopores.

This family includes a great number of zoarial forms classified by Gregory in his families of Petaloporidae and Zonatulae, in which the ovicell is identical. It includes also the forma *Multicavea* D'Orbigny, 1852. The ovicell of the latter and also that of *Zonopora* of the same author have been discovered by Canu in the French Cretaceous.

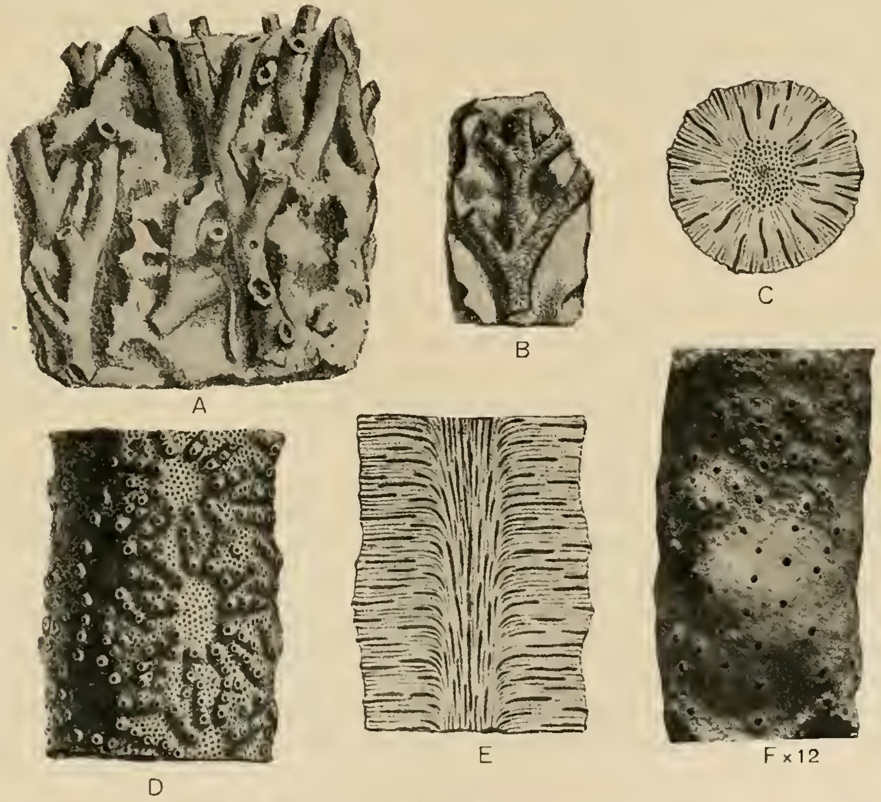

Fig. 277.—Forma *Multicavea* D'Orbigny, 1852.

A–F. *Multicavea magnifica* D'Orbigny, 1852. A, B. Zoaria, natural size. C. Transverse section of a branch, enlarged. D. Aspect of the zoarial surface, enlarged. E. Longitudinal section. (A–E, after D'Orbigny, 1852.) F. An ovicelled specimen from the Maastrichtian of Royan, France.

The genera recognized by Gregory are only zoarial forms. Thus the form called *Cavaria*, with hollow zoarium, presents ovicells of Ascosoeciidae (as *Parascosoecia consimilis* Ulrich, 1882), of Leiosoeciidae (as *Parleiosoecia jacksonica*, new species), and Tretocycloeciidae (as *Partretocycloecia exilis*, new species).

Moreover, the zoarial aspect called *Zonopora* results simply from the bifurcation of the mesopores; it can therefore occur without importance in any family containing adventitous tubes.

Gregory in 1909 distinguished the genera *Petalopora* and *Sparsicavea* by their ovicells. Our new observations show no fundamental difference between the ovicells of these two old genera, which appear to be otherwise only zoarial aspects; we have included them in the genus *Parascosoecia.*

### Genus ASCOSOECIA Canu, 1919.

1919. *Ascosoecia* CANU, Etudes sur les Ovicelles des Bryozoaires Cyclostomes (2), Bulletin Société Géologique de France, ser. 4, vol. 17, p. 347.

The tubes are cylindrical. The walls of the mesopores are vesicular.

*Genotype.*—*Ascosoecia* (*Zonopora*) *ligeriensis* D'Orbigny, 1852.

*Range.*—Neocomian-Midwayan.

In this genus it will be necessary to include the forms *Zonopora*, with bifurcated mesopores (as *Z. ligeriensis* D'Orbigny, 1853) and *Multicavea*, with peristomes arranged in radial rows (as *Multicavea magnifica* D'Orbigny, 1854).

#### ASCOSOECIA PROMINENS, new species.

Plate 108, figs. 17–25.

*Description.*—The zoarium is solid, arborescent, bushy, sometimes reticulate and borne on an expanded base. The tubes are cylindrical, bent horizontally at their extremity (in section). The peristomes are thin, orbicular, salient, irregularly arranged in quincunx. The mesopores are very small and polygonal. The ovicell is globular, very *salient*, orbicular.

| | | |
|---|---|---|
| *Measurements.*— | Diameter of the peristome | 0.14–0.16 mm. |
| | Diameter of the ovicell | 1.65 mm. |
| | Diameter of the branches | 2.5 mm. |

This species is quite well characterized by its salient peristomes; but this character is easily lessened on the worn specimens. The number of tubes between the mesopores is irregular. In longitudinal section the mesopores are almost as wide as the tubes; they appear, on the contrary, much smaller in tangential section. There is probably a thickening of their walls at their extremity. The sections of this species are very difficult to interpret and its structure is still not clearly understood.

*Affinities.*—*Ascosoecia prominens* differs from *Tretocycloecia attenuata* Ulrich, 1882, in the thinness of the walls of the mesopores.

*Occurrence.*—Midwayan (Clayton limestone): Mabelvale, near Little Rock, Arkansas (common).

*Cotypes.*—Cat. No. 65440, U.S.N.M.

#### ASCOSOECIA ? (ZONOPORA) ULRICHI, new species.

Plate 110, figs. 1–5.

*Description.*—The zoarium is free, cylindrical, solid, bushy, or reticulate. The tubes are very long, cylindrical, bent at their extremity (in section). The peristomes are rather thick, nonsalient, grouped in quincunx in irregular, transversal zones.

The mesopores are small, polygonal, separated by thick walls, grouped in transversal zones, alternating with the zones of the peristomes, and (in section) with vesicular walls and often ramified.

| | | |
|---|---|---|
| *Measurements.*— | Diameter of the peristome | 0.14 mm. |
| | Diameter of the apertura | 0.10 mm. |
| | Diameter of the branches | 4.00 mm. |
| | Diameter of the cancelli | 0.06 mm. |

This species was noted in 1882 [1] by Ulrich, who discovered the nature of the tubes and mesopores of *Zonopora.*

We have not discovered the ovicell, so our generic reference is quite doubtful. The resemblance of this species to *Zonopora ligeriensis* D'Orbigny, 1853, has caused us to classify it provisionally in our new genus.

We know that the large zones of mesopores are formed by their branching; but the latter appears to be rather irregular, so that the longitudinal sections are always somewhat confused.

*Affinities.*—This species differs from *Tretocycloecia reticulata* in its somewhat smaller micrometric measurements.

*Occurrence.*—Midwayan (Clayton limestone): Mabelvale, near Little Rock, Arkansas (rare).

*Cotypes.*—Cat. No. 65261, U.S.N.M.

## POLYASCOSOECIA, new genus.

The ovicell is globular, salient, spread between the fascicles whose length it auguments, placed eccentrically on the frontal. The tubes are cylindrical, oriented, short; they ramify into numerous mesopores on the frontal. The dorsal of the zoarium is thick, with lamellar structure, and perforated by vacuoles bent toward the base.

*Genotype.*—*Polyascosoecia coronopus*, new species.

*Range.*—Eocene-Pliocene.

Further remarks upon this new genus and a description of the genotype are included in a study of the cyclostomatous bryozoa now in press.

This genus differs from *Pleuronea* in which the ovicell is placed identically, not only in the different nature of the ovicell, but in its cylindrical tubes.

It differs from the genus *Erkosonea*, equally provided with pores on the two faces of the zoarium, in its ovicell placed laterally, and in its short cylindrical tubes.

### POLYASCOSOECIA JACKSONICA, new species.

Plate 134, figs. 1–21.

*Description.*—The zoarium is free, bifurcated, or dichotomous, with triangular section, often reticulated. The fascicles are very little salient, composed of four tubes, arranged alternately on each side of the median crest and quite close to it.

---

[1] 1882. Journal Cincinnati Society Natural History, p. 143.

The tubes are invisible and hidden by the zoarial calcification; the peristome is orbicular or rectangular; the frontal supports two vacuoles at least. The sulci are scarcely visible on the dorsal and the vacuoles appear very small and arranged in quincunx. The ovicell is very large and quite porous, spread over the median crest and in six interfascicular spaces.

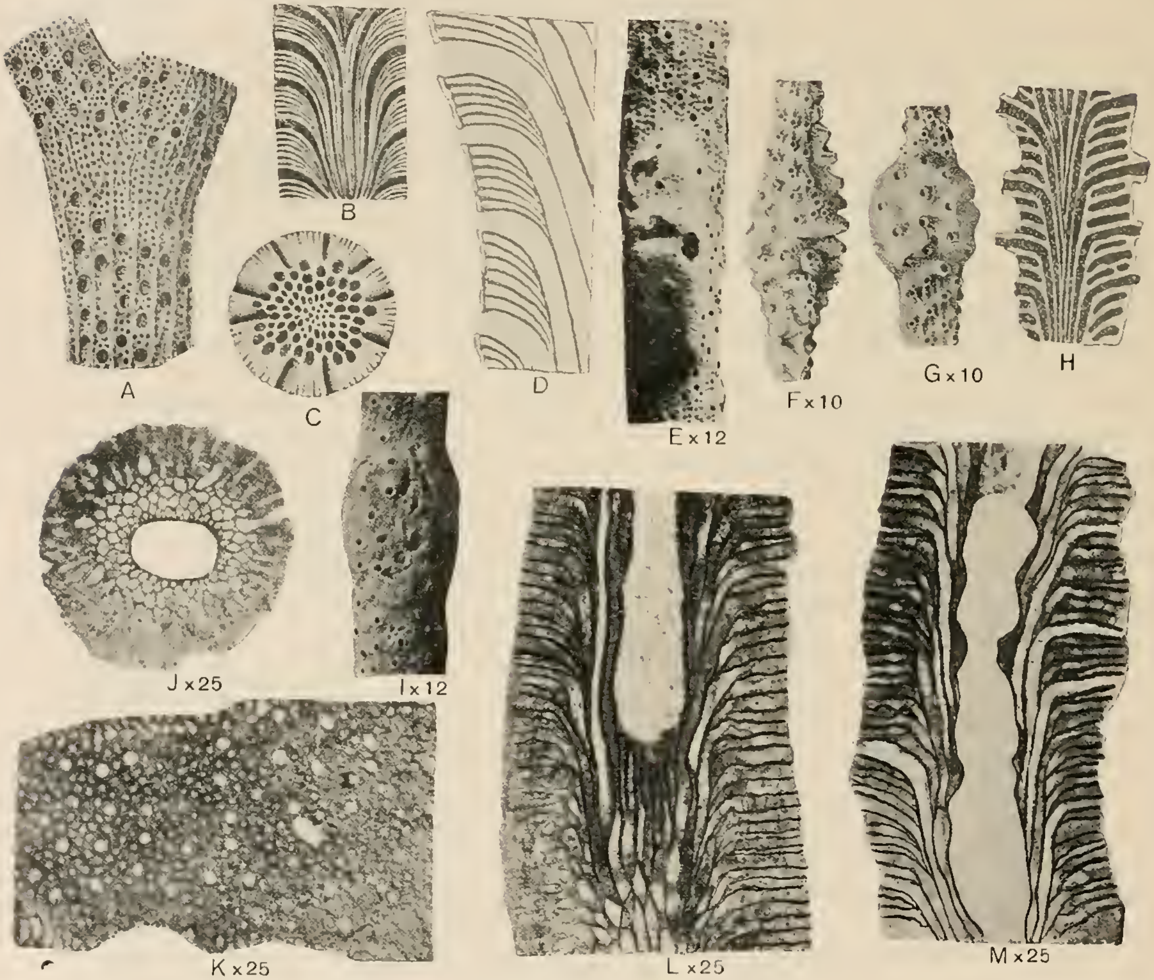

Fig. 278.—Genus *Parascosoecia* Canu, 1919.

A–E. *Parascoseccia* (*Petalopora*) *costata* D'Orbigny, 1851. A. Surface of zoarium, enlarged. B, C. Longitudinal and transverse section, magnified. (A–C. After Novak, 1877.) D. Longitudinal thin section. (After Pocta.) E. View of zoarium, × 12, showing the ovicell pierced by the tubes.

F–H. *Parascosoecia* (*Sparsicavea*) *carantina* D'Orbigny, 1853. F, G. Specimens with ovicells, × 10, from Cretaceous of England. H. Longitudinal section, × 14. (F–H. After Gregory, 1899.)

I–L. *Parascosoecia* (*Heteropora*) *consimilis* Ulrich, 1882. I. Ovicelled specimen, × 12, from the Midwayan at Mabelvale, Arkansas. J. K. M. Transverse, tangential, and longitudinal thin sections, × 25. L. Vertical section, × 25, showing tubules of consolidation.

| | | |
|---|---|---|
| *Measurements.*— | Distance between the lines | 0.24–0.26 mm. |
| | Width of the lines | 0.20 mm. |
| | Diameter of the peristome | 0.10–0.12 mm. |
| | Maximum width of the branches | 1.25 mm. |

*Variations.*—The polymorphism of this species is unprecedented. If the number of the specimens found had not permitted the discovery of the intermediate forms, it might have appeared that many new species were represented. An interesting variation is that shown by the young branches; the tubes do not bear any vacuoles: their frontal is concave, bordered laterally, and of a microscopic structure analogous to that of the other Cyclostomata.

The longitudinal section shows very numerous vacuoles. The successive lamellae have no regularity; they appear to be formed by very thick walls of tergopores irregularly branched and entangled. This is therefore only one aspect of lamellar structure. In transverse section these pseudo-lamellae are still more irregular; they appear to result from the juxtaposition of the tergopores arranged parallel to the basal lamella.

The tangential section of the dorsal shows that the vacuoles perforate a sort of olocyst with large elements.

The abrasion of the dorsal vacuoles and of the basal lamella shows that in the interior the tubes have the fusiform appearance and are arranged as in the other free Cyclostomata having only one cellular face.

The zoarium is supported by an expanded base. Only a single specimen with the base has been found and we have not been able to discover the ancestrula by successive sections.

*Affinities.*—This species differs from *Polyascosoecia cancellata* Reuss, 1847 (not Goldfuss), in its fascicles which are quite close to the median crest.

It differs from *Polyascosoecia foraminosa* Reuss, 1865, in its smaller vacuoles and in its fascicles not distant from the median crest.

This may possibly be *Polyascosoecia subcancellata* Manzoni, 1877, but that author has neglected to figure the anterior face of the zoarium, the aspect of which is unknown to us.

*Occurrence.*—Middle Jacksonian: Rich Hill, $5\frac{1}{4}$ miles southeast of Knoxville, Crawford County, Georgia (very abundant); Baldock, Barnwell County, South Carolina (common); 17 miles northeast of Hawkinsville, Georgia (common); $3\frac{1}{2}$ miles south of Perry, Georgia (very abundant); $3\frac{1}{2}$ miles north of Grovania, Georgia (common); one-half mile southeast of Georgia Kaolin Co. mine, Twiggs County, Georgia (very common), 12 miles southeast of Marshallville, Georgia (abundant); Eutaw Springs, South Carolina (rare); 18 miles north of Wrightsville, Johnson County, Georgia (common); $1\frac{1}{2}$ miles southeast of Lilly, Dooly County, Georgia (common).

This species exists in almost all the localities of the middle Jacksonian, although it has not yet been found at this horizon at Wilmington, North Carolina.

*Cotypes.*—Cat. Nos. 65333, 65334, U.S.N.M.

### POLYASCOSOECIA IMBRICATA, new species.

Plate 141, figs. 28–33.

*Description.*—The zoarium is free, bifurcated, or arborescent, with triangular section. The fascicles are little salient, formed of three or four tubes and arranged alternately on each side of the median crest to which they are almost adjacent. The tubes are invisible and hidden by two or three vacuoles. The peristome is quadrangular and more salient in its proximal portion. On the dorsal the longitudinal sulci are little deep. The vacuoles are funnel-shaped and close together.

| | | |
|---|---|---|
| *Measurements.*— | Distance between the fascicles | 0.25 mm. |
| | Width of the fascicles | 0.25 mm. |
| | Diameter of the tubes | 0.20 mm. |
| | Maximum width of the zoarium | 1.6 mm. |

*Affinities.*—This species is characterized by the special arrangement of the fascicles which appear imbricated one above the other, on account of the saliency of the proximal portion of the peristome.

It differs from *Polyascosoecia jacksonica* in its wider tubes (0.20 and not 0.12 mm.) and in its large vacuoles.

*Occurrence.*—Lower Jacksonian (Moodys marl): Jackson, Mississippi (rare).

*Cotypes.*—Cat. No. 65342, U.S.N.M.

## Genus PARASCOSOECIA Canu, 1919.

1919. *Parascosoecia* CANU, Études sur les Ovicelles des Bryozoaires Cyclostomes (2), Bulletin Société Géologique de France, ser. 4, vol. 17, p. 347.

The tubes are club-shaped. The mesopores have no vesicular walls.

*Genotype.*—*Parascosoecia* (*Cavea*) *costata* D'Orbigny, 1851.

*Range.*—Cenomanian-Midwayan.

The form ***Petalopora*** is characterized by the very great regularity in the arrangement of the mesopores. The latter are of equal length in *Sparsicavea.* Finally, the hollow forms have been termed *Cavaria.* But all those forms are again found equally in the other families with mesopores.

### PARASCOSOECIA CONSIMILIS Ulrich, 1882.

Plate 110, figs. 6–15.

1882. *Heteropora consimilis* ULRICH, American Paleozoic Bryozoa, Journal Cincinnati Society Natural History, vol. 5, p. 144, pl. 6, fig. 11.

1909. *Petalopora consimilis* GREGORY, Catalogue Fossil Bryozoa in Department Geology British Museum Cretaceous, vol. 2, p. 320.

*Description.*—The zoarium is hollow (*Cavaria*), cylindrical, dichotomous, arborescent. The tubes are short, club-shaped at first, cylindrical and convex at right angles at their extremities (in section); the peristomes are orbicular, very little or not salient, arranged in irregular quincunx. The mesopores are small, polygonal, numerous, closed by a calcareous lamella. The ovicell is very large, elliptical, as wide as the branches.

*Measurements.*—

| | |
|---|---|
| Diameter of the peristome | 0.14 mm. |
| Diameter of the apertura | 0.09 mm. |
| Dimensions of the ovicell | 2.00 by 1.40 mm. |
| Diameter of the mesopores | 0.04 mm. |
| Diameter of the branches | 2.00–3.00 mm. |

*Variations.*—The peristome is rarely visible. The zoarial cavities are completely closed; they are often laterally constricted, preceded and followed by firmatopores, their dimensions and their forms are absolutely irregular, and we have not yet discovered the reason for their formation.

*Affinities.*—This species differs from *Ascosoecia prominens* in its hollow zoarium and in its club-shaped tubes.

The ovicell is absolutely analogous to that of *Cavea costata* D'Orbigny, 1851, but the mesopores are irregularly disseminated and not grouped symmetrically on a double row between the peristomes.

This species shows by the form of its ovicell that the generic distinction made by Gregory between *Petalopora*, *Sparsicavea*, and *Cavaria* is useless.

*Occurrence.*—Midwayan (Clayton limestone): Mabelvale, near Little Rock, Arkansas (very common); 1 mile west of Fort Gaines, Georgia (common).

*Cotypes.*—Cat. No. 65262, U.S.N.M.

### Order CTENOSTOMATA Busk.

Fossil representatives of this order of the Bryozoa are extremely rare compared with those of the other orders. In the Recent seas the Ctenostomata are likewise the least represented group of Bryozoa specifically, although some of the species are quite abundant and widespread. But a single form of this order has been discovered so far in the North American Early Tertiary rocks and it is too poorly preserved to merit description as a well-defined species.

In the Ctenostomata the zooecia are usually isolated and developed by budding from the internodes of a distinct tubular stolon or stem. The orifice is terminal and has an operculum of setae. Marsupia are wanting. The zoarium is horny or membranaceous.

All of the known Paleozoic Ctenostomata have been described by Ulrich and Bassler in their Revision of the Paleozoic Bryozoa.[1] Little study has been put upon the Mesozoic and Cenozoic forms but the Recent species have been the subject of numerous papers.

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[1] 1904. Ulrich and Bassler, Smithsonian Miscellaneous Collections, vol. 45, pp. 256–294, 4 pls.

## Family TEREBRIPORIDAE D'Orbigny, 1839.

*Bibliography.*—1839. D'Orbigny, Voyage dans l'Amerique Meridionale, vol. 5, pt. 4, Zoophytes, p. 22, pl. 10, figs. 16–19.—1866. Fischer, Étude sur les Bryozoaires perforants de la famille des Terebriporides, Nouvelles Archives du Museum d'Histoire Naturelle, vol. 2, pp. 293–313.—1880. Jullien, Description d'une nouvelle espèce de Bryozoaire perforant du genre *Terebripora* D'Orbigny, Bulletin Société Zoologique de France, vol. 5, p. 5.

Broyozoa perforating very superficially the enamel of shells. The zoarium is a more or less complicated network of small canals in which the zooecia are inserted. The latter bear an aperture provided with a rimule.

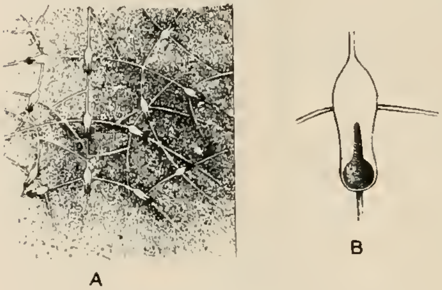

Fig. 279.—Genus *Terebripora* D'Orbigny, 1839.

A, B. *Terebripora ramosa* D'Orbigny, 1839. A. Zoarium enlarged; primitive axis longitudinal, secondary axis transverse; many small anastomising canals between the axes of different orders are seen. B. Zooecium much enlarged. The small canals leave the sides of the zooecium toward its middle. (After Fisher, 1866.)

The Terebriporidae are not rare on the present seacoasts; nevertheless they have never been the object of anatomical research. Jullien thought that they might belong to the Hydroids. Their place in the Ctenostomata is doubtful.

There are only two known genera, *Spathipora* Fischer, 1866, and *Terebripora* D'Orbigny, 1839, differing from each other in the method of branching of the small canals.

### Genus TEREBRIPORA D'Orbigny, 1839.

1839. *Terebripora* D'Orbigny, Voyage dans l'Amerique Meridionale, vol. 5, pt. 4, Zoophytes, p. 22.

The zooecia are arranged on the axes of minute canals, which in branching emerge from the primary axis at the point of attachment of a zooecium.

*Genotype.*—*Terebripora ramosa* D'Orbigny, 1839.

*Range.*—Jurassic-Recent.

#### TEREBRIPORA, species undetermined.

Plate 112, fig. 13.

Of this species we have found only a fragment, which is a rather vague imprint not meriting a detailed description. The zooecia are very elongate; their dorsal, which is as usual very thin, is sometimes broken. The zoarium is very incomplete, but the arrangement of the ramifications leaves no doubt as to the generic determination. It is useless to give a name to such a poor fragment, and the present notice is simply to indicate the presence of the genus in the Midwayan and to call the attention of collectors to it.

*Occurrence.*—Midway (Porters Creek formation): Three miles north of Scooba, Kemper County, Mississippi (very rare).

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